22

STANDING COMMITTEE ON COAL AND STEEL (2015-2016)

SIXTEENTH LOK SABHA

MINISTRY OF MINES

SCIENCE & TECHNOLOGY/RESEARCH & DEVELOPMENT IN MINING SECTOR

TWENTY SECOND REPORT

LOK SABHA SECRETARIAT
NEW DELHI
August, 2016/Sravana, 1938(Saka)

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(SIXTEENTH LOK SABHA)

MINISTRY OF MINES

SCIENCE & TECHNOLOGY/RESERACH & DEVELOPMENT IN MINING SECTOR

Presented to Lok Sabha on 10.8.2016

Laid in Rajya Sabha on 10.8.2016

LOK SABHA SECRETARIAT
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COMPOSITION OF THE STANDING COMMITTEE ON COAL AND STEEL(2015-16)

Shri Rakesh Singh- Chairperson

Name of the Member

Lok Sabha

2. Shri A Arunmozhithevan
3. Shri Kalyan Banerjee
4. Shrimati Jyoti Dhurve
5. Shri Godam Nagesh
6. Shri Faggan Singh Kulaste$
7. Shri Shailesh Kumar
8. Dr. Banshilal Mahato
9. Shri Devji Mansingram Patel
10. Shrimati Riti Pathak
11. Shrimati Ranjit Ranjan
12. Dr. Ravindra Kumar Ray
13. Shri Neiphiu Rio
14. Shri Tamradhwaj Sahu
15. Shri Tathagata Satpathy
16. Shri Janardan Singh "Sigriwal"
17. Shri Pashupati Nath Singh
18. Shri Rama Kishore Singh
19. Shri Sunil Kumar Singh
20. Shri Sushil Kumar Singh
21. Shri Krupal Balaji Tumane

Rajya Sabha

22. Shri M.J. Akbar@
23. Shri Ali Anwar Ansari
24. Dr. Pradeep Kumar Balmuchu
25. Md. Nadimul Haque
26. Shri B.K Hariprasad
27. Dr. Satyanarayan Jatiya
28. Shri Jugul Kishore#
29. Shri Avinash Pande#
30. Shri Sanjay Raut#
31. Shri Dilip Kumar Tirkey
32. Shri Narayan Lal Panchariya*
33. Shri Beni Prasad Verma*

$ Ceased to be a Member of the Committee w.e.f. 5.7.2016 on his induction in the Council of Ministries.

@Ceased to be a Member of the Committee w.e.f. 17.6.2016 after his resignation from Membership of Rajya Sabha.

#Ceased to be a Member of the Committee w.e.f. 4.7.2016 after his retirement from Rajya Sabha.

* Nominated w.e.f. 25.7.2016.

SECRETARIAT

1. Shri U.B.S. Negi - Joint Secretary
2. Shri Ajay Kumar Garg - Director
3. Shri Arvind Sharma - Additional Director
4. Ms. Miranda Ingudam - Deputy Secretary
5. Smt. Madhu Tandon - Sr. Executive Assistant

INTRODUCTION

I, the Chairperson, Standing Committee on Coal and Steel having been authorized by the Committee to present the Report on their behalf, present this Twenty-second Report (Sixteenth Lok Sabha) on Science & Technology/Research & Development in Mining Sector relating to the Ministry of Mines.

2. The Standing Committee on Coal and Steel (2015-16) had selected the subject for detailed examination and report to the Parliament. The Committee were briefed by the representatives of the Ministry of Mines and PSUs on 30.9.2015 and took oral evidence on 16.2.2016. Based on the oral and written testimony submitted to the Committee, a report on the subject was prepared.

3. The Committee wish to express their thanks to the officials of the Ministry of Mines and PSUs for placing before them and in furnishing material/information from time to time as desired by the Committee.

4. The Committee considered and adopted the Report at their sitting held on 9.8.2016.

5. The Committee place on record their profound appreciation for the valuable assistance rendered to them by the officials of the Lok Sabha Secretariat attached to the Committee.

6. For facility of reference and convenience, the observations and recommendations of the Committee have been printed in bold letters in Part-II of the Report.

NEW DELHI;
9 August, 2016
18 Shravana, 1938(Saka)

RAKESH SINGH
Chairperson
Standing Committee on Coal and Steel

Report

Part -I

Chapter-I

Introductory

Research & Development in Mining Sector

The National Mineral Policy, 2008 seeks to ensure that the development of mineral resources keeps pace, and is in consonance with the national goals. Important areas of focus in the National Mineral Policy *inter-alia* include ushering in greater liberalization and private sector involvement, developing partnership with stakeholders viz. State Government, mineral and mineral based industries and various concerned Ministries/Departments of the Central Government; deepen scope of the development framework by mandating better management of resources, enhancing the imports on Research and Development and also by developing Human Resource in the sector; ensuing that the interests of host populations and other vulnerable sections are fully protected and the benefit of the economics activities in the mining sector flow equitably to the stakeholders.

Recognizing the paramount importance of safety, economy, speed and efficiency in extraction of ore resources and in its convergence into viable economic alloy and metals, the National Mineral Policy, 2008 has accorded higher priority to R&D programmes. With a view to promoting R&D in the mining sector, Ministry of Mines has launched a comprehensive Science & Technology Programme which includes (i) R&D component (ii) Information, Education and Communication (IEC) and (iii) one-time capital component for up-gradation of R&D facilities of Jawaharlal Nehru Research Development & Design Centre (JNRDDC), National Institute of Miners' Health (NIMH) and National Institute of Rock Mechanics (NIRM). In addition to these three autonomous bodies, three PSUs *viz.* National Aluminum Company Ltd. (NALCO), Hindustan Copper Limited (HCL) and Mineral Exploration Corporation Limited (MECL), one attached office i.e. Geological Survey of India (GSI) and one subordinate office i.e. Indian Bureau of Mines (IBM) also contribute to R&D sector.

The underlying principle behind R&D Component is to foster utilization of the available mineral resources judiciously, economically efficient and environmentally sustainable manner. Under the R&D component of the Science & Technology Programme, Research projects are funded through grant–in–aid. The broad thrust areas for supporting research in mining sector include – (i) Prospecting exploration for strategic rare and rare earth minerals. (ii) Research in mining methods. This includes rock mechanics, mine designing, mining equipment, energy conservation, environmental protection and mine safety. (iii) Improve efficiency in process, operations, recovery of by-products and reduction in specification and consumption norms. (iv) Research in metallurgy and mineral beneficiation techniques to utilize lower grade and finer size ores. (v) Extraction of value added products from mine waste, plant tailings etc. (vi) Development of new alloys and metal related products etc. (vii) Evolve low capital and energy saving processing systems (viii) Production of materials of high purity.

Based on scrutiny which passes through different stages of evaluation including presentation of shortlisted projects before the Project Evaluation and Review Committee (PERC) and final approval of an inter-ministerial Standing Scientific Advisory Group (SSAG) chaired by Secretary (Mines), grants are given to the projects submitted by R&D institutions

R&D related Investments by Organizations associated with Ministry of Mines

During the recent past organizations associated with Ministry of Mines are making investments of Rs. 75 crores per annum on R&D. This is projected to increase to about Rs. 87 crores in 2015-16 which depicts a significant increase of 19%. The comparative chart of related to organization wise R&D Investments is presented below:

(Rs. Crore)

Name of the Organization	**2013-14**	**2014-15**	**2015-16***
Science and Technology schemeMinistry of Mines	1.97	6.60	7.30
Autonomous Bodies			
Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC)	6.3	7.9	15.5
National Institute of Rock Mechanics (NIRM)	16.8	14.0	16.0
National Institute of Miners' Health (NIMH)	2.5	2.5	2.6

Non Ferrous Materials Technology Development Centre (NFTDC)	13.12	14.68	15.30
Public Sector Undertaking (PSUs')			
National Aluminium Company Limited (NALCO)	13.87	7.31	13.22
Hindustan Copper Limited (HCL)	3.1	2.9	0.71
(MECL)	0.30	0.39	0.42
Attached and Subordinates Offices			
Geological Survey of India (GSI)	8.25	12.56	12.63
Indian Bureau of Mines (IBM)	5.56	5.78	3.49
Total	**71.77**	**74.62**	**87.17**

* Projected

1.2 For fructification of principles as enunciated in the National Mineral Policy, guidelines for support to 'Mining Research' was issued in May 2013 by the Ministry of Mines. It seeks to provide renewed scientific impetus to address the emerging mining challenges, broaden the participation of stakeholders, introduce the concept of cost-sharing and make the research in Mines more productive, with an emphasis on outputs and outcomes. The Guidelines set forth the objectives and thrust areas of research, procedure for invitation and processing of research proposals for funding support, norms for funding, conditions of support and participation of public and private sectors in mutually agreed bilateral, multilateral, cross-sectoral and inter-institutional projects. Special attention has been given to dissemination of research findings and scaling up of the leads, which are generated through research projects and are of societal relevance. Statedly the vision of the R&D Schemes is to promote research in applied geosciences, mineral exploration, mining and allied areas, mineral processing, optimum utilization and conservation of the mineral resources of the country, for the benefit of the nation and its people. The pronounced mission is to plan, support and coordinate mining research in public interest for enhancing the understanding of the mines and geology, and devising strategies and solutions for conservation and mining protection and management. The guidelines also broadly define the thrust areas of research in Mines and the scope and coverage of research grants for R&D projects.

1.3 The underlying principle behind the R&D Component in the Science and Technology Programme is to foster utilization of the available mineral resources judiciously, economically, efficiently and in an environmentally sustainable manner.

Under the R&D component of the Science & Technology Programme, Research projects are funded through grant–in–aid. The broad thrust areas for supporting research in mining sector include – (i) Prospecting exploration for strategic rare and rare earth minerals; (ii) Research in mining methods which includes rock mechanics, mine designing, mining equipment, energy conservation, environmental protection and mine safety; (iii) Improve efficiency in process, operations, recovery of by-products and reduction in specification and consumption norms; (iv) Research in metallurgy and mineral beneficiation techniques to utilize lower grade and finer size ores; (v) Extraction of value added products from mine waste, plant tailings etc.; (vi) Development of new alloys and metal related products etc.; (vii) Evolve low capital and energy saving processing systems; and (viii) Production of materials of high purity.

Chapter-II

Science & Technology Programme in Mining Sector

2.1 The Science & Technology programme which has been operational since 1978 has three components, namely:

- R&D Component
- Information Education and Communication Component
- One Time Capital Grant Component

Funds released to the various institutes under S&T Programme Scheme during the last three years are given as under:

(Rs.in crores)

Year	Budget Estimate	Revised Estimate	Expenditure
2013-14	Rs. 3.97	Rs. 1.97	Rs. 1.97
2014-15	Rs. 6.60	Rs. 6.60	Rs. 6.60
2015-16*	Rs. 7.30	--	Rs. 3.22

*one time capital component for up-gradation for R&D facility.

2.2 During the Financial Year 2014-15, funding to the tune of Rs. 6.60 crore was released for 16 approved projects. For the year 2015-16, the Ministry received 86 proposals which were under scrutiny of the Expert Committee for selecting the proposals on the basis of the identified thrust areas as enunciated in 2013 guidelines.

With the participation of large number of Research Institutes, the Scheme has become more broad based. During 2014-15, various research proposal pertaining to many Institutes have been cleared. This includes *inter-alia* research projects of Jawaharlal Nehru Research Development & Design Centre, National Institute of Miners' Health and National Institute of Rock Mechanics, the proposals of Institutes of Non Ferrous Material Technology Centre for purification of commercial Rare Earth Oxides, Indian School of Mines for development of low density emulsion explosives, Aligarh Muslim University for study on Synthesis, characterisation and photocatalytic performance of Metal doped semiconductor Nano-Materials, Indian Institute of

Technology, Roorkee for study of Alkaline Carbonatite, Indian Institute of Technology, Khargpur for development of Nickel containing steel from Chromite over burden, Gandhi Institute of Engineering and Technology, Odisha for study on production on Geopolymer based construction material from pond ASH, National Institute of Technology, Rourkela, for development Time Domain Reflectometry (TDR) based wireless system for slope, Directorate of Geology and Mining, Govt. of Nagaland for prospecting/exploration of platinum groups of metals.

R&D Works undertaken by the Ministry of Mines

2.3 On being enquired by the Committee about the details of the Research and Development works undertaken by the Ministry/organization for prospecting/exploration of strategic rare and rare earth minerals, research in mining methods including rock mechanics, mine designing, mining equipment, energy conservation, environmental protection and mine safety, the Ministry of Mines in its written response furnished the following information:

A. Research Programme supported by Ministry of Mines under Science and Technology Programme

Sl. No	Name of Project/ Duration	Name & Address of Institute
Prospecting/exploration of strategic rare and rare earth minerals		
1.	Purification of commercial rare earth oxides, e.g. Ceria, by molten salt fusion and re-crystallization.	Non-Ferrous Material Technology Development Centre (NFTDC), Hyderabad
2.	Physico-chemical processing of low grade chromite ore for beneficiation and agglomeration of fines for recovery of metal values.	Jadavpur University, Kolkata
3.	Study of alkaline-carbonatite complexes as potential resource for REEs, NB-TA and U-TH	Institute of Technology, Roorkee
4.	Prospecting/Explorations of Platinum group of metals within Naga Hills ophiolite at Thengahu Ridge-Moke area, Phek District, Nagaland.	Directorate of Geology and mining, Government of Nagaland

Research in mining methods including rock mechanics, mine designing		
5.	Development of low density emulsion explosives for energy efficient blasting in environmentally sensitive areas	Indian School of Mines, Dhanbad
Energy conservation, environmental protection and mine safety		
6.	Development of copper bio-leaching methodology/ technique from tailing waste at Hindustan copper limited, Khetri, Birla Institute of Technology & Science, Pilani.	Civil Engineering Department, Birla Institute of Technology & Science, Pilani, Rajasthan
7.	Development of TDR based wireless system for slope stability monitoring in opencast mines	National Institute of Technology, Rourkela.
8.	Value addition in mine waste tailing materials through geopolymer formation, Christ University, Faculty of engineering Kaniminike, Kumbalagodu, Bangalore.	Deptt. of Mechanical EngineeringChrist University,Faculty of Engineering, Kumbalagodu, Kaniminike, Bangalore
9.	Development of Standard Framework and Guidelines for Noise Mapping in Mines and Surrounding Community, NIMH, Nagpur.	National Institute of Miners Health, JNARDDC, Campus, Amravati Road, Wadi, Nagpur
10.	Development of viable technique for assessment of reclaimed land and for safety of structures under settling environment.	National Institute of Rock Mechanics, Champion Reefs, Kolar Gold Fields-Karnataka
11.	Estimation of seismic hazard in and around the mines out areas of Kolar Gold Fields,	National Institute of Rock Mechanics, Champion Reefs, Kolar Gold Fields-Karnataka.
12.	Beneficiation of low grade iron ore and tailings by selective flocculation.	Indian School of Mines, Dhanbad. (Jharkhand)
13.	Evaluation of Biomarkers for early detection of noise induced hearing loss.	National Institute of Miners Health, JNARDDC, Campus, Amravati Road, Wadi, Nagpur
14.	Multi Centric Study of dust related diseases in stone mines and development of sustainable preventive program.	National Institute of Miners Health, JNARDDC, Campus, Amravati Road, Wadi, Nagpur
15.	Study of toxic fumes and development of Carbon nanotubes based sensing Device, CIMFR and Amity University (Jointly) (Duration 3 Year)	Central Institute of Mining & Fuel Research, Dhanbad, Jharkhand

B. NALCO

R&D Works undertaken by NALCO for prospective/ exploration of strategic metals and rare earth minerals, research in mining methods including rock mechanics, mine designing, mining equipment, energy conservation, environmental protection and mine safety are as given below:

i. **Rare Metals**: For exploration of rare metals such as gallium and vanadium, study was under progress.

ii. Trial production of about 6 MT of vanadium sludge done successfully. Vanadium balance was being done to find out feasibility of setting up of a plant.

iii. Regarding production of Gallium, it is being explored for MoU with Chalieco, China, for R&D co-operation in the field of Gallium and its technology developments.

iv. **Environmental protection**: For treatment of surface water having fluoride, pilot scale study was done successfully. Proposal for setting up of a plant using nano-technology for control of fluoride was under process.

v. **Energy Conservation**: NALCO had R&D co-operation agreement with AP/ RTA, Canada, the technology provider for out Smelter Plant to upgrade the pots with higher amperage with a target to increase the productivity of the pots upto 9%, thereby reduction of specific power consumption by >5%. The technology was named as AP2XN.

vi. A collaborative R&D project for extrusion of rare earth elements from Red mud was in progress with NML, Jamshedpur.

C. GSI

Research and Development (R&D) in GSI was restricted to assessment of mineral resources, characterization of ore mineralization and understanding of the genesis of minerals which has long term impact on the mining sector for understanding the nature of the mineral deposit. GSI's main focus was to establish subsurface behavior of the mineralization, tonnage etc. Services of three National Centers for Geoscience Research' (NCEGR) of GSI situated at Kolkata, Bengaluru and Faridabad engaged in research on fundamental geosciences were being taken for future R&D work with respect to mineral characterization

and ore beneficiation. At present there is no specific R&D project by GSI on strategic rare and rare earth minerals. However, GSI had taken up regular exploratory items for exploring these minerals in XII Five Year Plan. Rare Earth Element (REE) occur usually in very low content (<1%) in rocks. Hence, these are difficult to locate and identify by normal megascopic and microscopic techniques, which were used in identification of rock–forming minerals that occur in major to minor quantities (>1%). The present investigation strategy of GSI for search of REE mineralisation includes identification of zones of anomalous concentration of Rare Metal (RM)/ Rare Earth Element (REE) on the basis of Base Line Geoscience Data Generation (STM & NGCM) and delineation of target zones for enhanced potential through reconnaissance stage investigations. If enhanced potentiality was established in the area, follow up investigation under prospecting stage was carried out.

GSI was trying to collect and examine the chemical and other data generated from the past mapping and investigation reports for locating suitable target areas for further search of REE.

52 programmes have been taken up by GSI for search of REE in XII Plan period in the states of Tamil Nadu, Uttar Pradesh, Andhra Pradesh, Jharkhand, West Bengal, Orissa, Rajasthan, Gujarat and Meghalaya."

R&D Work for Mineral Beneficiation Techniques

2.4 As regards the R&D works that had been done in identifying mineral beneficiation techniques to utilize lower grade and finer size ores and development of new alloys and metal related projects, the Ministry of Mines apprised the Committee in writing as under :-

A. "Ongoing beneficiation projects supported by Ministry of Mines under Science and Technology Programme were provided in the table below:

Sl. No.	Name of Project/ Duration	Name & Address of Institute
1.	Development of hard and high temperature refractory material/aggregate from saprolite	Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC),Nagpur.
2.	Development of Nickel containing steel from chromite over burden	Indian Institute of Technology, Kharagpur and Institute of Minerals & Materials Technology, Bhubaneswar (Jointly)
3.	Novel synthesis routes for high purity kesterites (CZTS:Cu-Zm-Sn-S; Cu-Zn-Sn-Se) and development of cost kesiterite based solar PV cells and modules	Nonferrous Materials Technology Development Centre, Hyderabad
4.	Recovery of copper from copper smelter dust and novel fixation of arsenic in geopolymer matrix derived from converter slag- Scientific and techno-feasibility studies. Phase- 1 Lab scale studies on copper recovery from Cu flue dust and TCLP studies for Arsenic fixation, NFTDC, Hyderabad	Nonferrous Materials Technology Development Centre, Kanchanbagh, Hyderabad.
5.	Development of process for making value added materials from ilmenite mineral.	Advanced Materials Technology Department, Institute of Minerals & Materials Technology, Bhubaneswar.
6.	Development of portable analytical kit for field analysis of bauxite: Emphasis on In-situ Micro-Analysis of Mineral Entitites for Mineral Prospecting.	Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur.
7.	Process Development for production of low soda (Na2O) hydrate in Bayer Circuit.	Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur.
8.	Up-gradation & Utilization of Laterite of East and West Coast deposits.	Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur.
9.	Development of Mathematical Model (using fuzzy logic) to Control superheat of Aluminium Electrolysis Bath.	Jawaharlal Nehru Aluminium Research & Development & Design Centre, Nagpur.
10.	Characterisation of Indian lean grade magnesite ore and improvement of its high temperature refractory properties with or without beneficiation.	Central Glass & Ceramic Research Institute, 196, Raja S.C.Mullick Road, Kolkata.

11.	Mineral systematics and pre-concentration of PGE values from low grade chrome ores of Boula mines, orissa.	Institute of Minerals & Materials Technology, Council of Scientific & Industrial Research, Bhubaneswar Orissa.
12.	Development of Multilayered materials for melting, liquid metal handling and casting under high pressure and loads.	Non-Ferrous Materials Technology Development Centre (NFTDC), Hyderabad.

Projects related to development of new alloys and metal supported by Ministry of Mines under Science and Technology programme are provided in the table below:

Sl. No	**Name of Project/ Duration**	**Name & Address of Institute**
1.	Integrated approach for development of process models and pilot production of aluminium alloy extrudates using porthole dies	Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC),Nagpur.
2.	Synthesis, characterization and photocatalytic performance of metal doped semiconductor nanomaterials	Aligarh Muslim University, Aligarh.
3.	Production of geopolymer based construction material from pond ASH: an industrial waste	Gandhi Institute of Engineering and Technology,Gunupur, Odisha.
4.	Development of a real time instrument/system to measure bath ratio, alumina concentration and superheat of the Aluminium electrolysis bath.	Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur.
5.	Development of Super Thermal Aluminium (STAL) conductor for Indian Power Sector.	Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur and Non-Ferrous Technology Development Centre, Hyderabad.

B. NALCO

Following R&D had been done by NALCO for mineral beneficiation techniques to utilize lower grade:

(i) R&D Works for Mineral beneficiation to utilize lower grade ores:

For extraction of Alumina from low grade ore i.e. Partially LateratisedKhondalite (PLK), NALCO has undertaken a collaborative project with CSIRO, Australia. Further study is going on.

(ii) New Alloy and Metal Related Projects:

(a) Collaborative project proposal for development of Al-Li Alloy Metal Matrix is being studied.

(b) Trial production of high speed extrusion alloy done and its performance was tested at Jindal Aluminium, Bangalore. It was found to be better than normal billets. In order to confirm the findings further trials at different plants are in progress.

(c) Developmental trial production of cookware from Rolled Product sheets has been successful at two different cookware industries. Marketing and production departments have been intimated to take up cookware further for commercialization.

C. JNARDDC, Nagpur

The work had been carried out by some agencies/ organizations on beneficiation of bauxite by various techniques such as tabling, magnetic separation, acid leaching etc. JNARDDC had rich experience in beneficiation of low grade bauxite/laterite ores.

JNARDDC, which had world class analytical facilities and highly qualified & trained manpower, had offered services in the field of Bauxite Processing (Characterization & Technological Testing) to **almost all** those

companies in the country engaged in mining, processing or export of bauxite ore, in the last 25 years of its existence.

During the period 2009-14, JNARDDC had carried out beneficiation studies on low grade bauxite/ laterite deposits in Gujarat (Sabarkantha, Kachchh and Jamnagar) employing various techniques such as crushing, grinding, magnetic separation, acid leaching and gravity separation etc obtaining satisfactory results.

Following R&D work has been undertaken in identifying mineral beneficiation techniques to utilize lower grade and finer size ores:-

(i) Various beneficiation techniques such as sieving/ screening, magnetic separation, acid leaching, roasting, floatation and hydro cyclone have been adopted for quality improvement of low grade bauxite and Laterite under various projects. Presently the following S&T project was under execution.

(ii) Upgradation & utilization of laterite of East- and West Coast deposits.

(iii) R&D work had also been undertaken in development of new alloys in the following project.

(iv) Development of Super Thermal Aluminium Alloy (STAL) conductor for Indian Power sector

2.5 When the Committee asked about the details of governmental/non-governmental bodies which are engaged in the R&D activities in the mining sector and the initiatives that have been taken by the Government to synergise such initiatives in order to maximize the R&D outcomes, the Ministry in its written reply stated as under:

The names of the agencies which were associated with the Ministry of Mines under R&D activities through S&T programme in the Mining Sector are given as below:

i Non-Ferrous Material Technology Development Centre (NFTDC), Hyderabad

ii Jadavpur University, Kolkata

iii Institute of Technology, Roorkee

iv Directorate of Geology and Mining, Government of Nagaland

v Indian School of Mines,Dhanbad

vi Birla Institute of Technology & Science, Pilani, Rajasthan

vii National Institute of Technology, Rourkela.

viii Christ University, Faculty of Engineering, Kumbalagodu, Kaniminike, Bangalore

ix National Institute of Miners Health, JNARDDC, Campus, Amravati Road, Wadi, Nagpur

x National Institute of Rock Mechanics, Champion Reefs, Kolar Gold Fields-Karnataka

xi Central Institute of Mining & Fuel Research, Dhanbad, Jharkhand

xii Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC),Nagpur.

xiii Aligarh Muslim University, Aligarh.

xiv Indian Institute of Technology, Kharagpur

xv Institute of Minerals & Materials Technology, Bhubaneswar

xvi Gandhi Institute of Engineering and Technology, Gunupur,Odisha.

xvii Central Glass & Ceramic Research Institute, 196, Raja S.C.Mullick Road, Kolkata.

In addition, PSUs of Ministry of Mines i.e. NALCO, MECL and HCL: sub-ordinate office of IBM and attached office of GSI have their own R&D programme which was also monitored by Ministry of Mines through their work programme discussion and periodic reviews of the PSUs in the Ministry. The endeavor of Ministry of Mines was to synergise the efforts to achieve the objectives as enunciated in the National Mineral Policy (NMP) 2008."

2.6 According to the Ministry of Mines, India is far behind in R&D at world level and ranked 48th in capacity innovation and 52nd in scientific institution and 30th in R&D expenditure in the world. When the Committee asked to state the standards/parameters on the basis of which this 'ranking' has been awarded, the Ministry responded in writing as under:-

"The Standard/parameters on the basis of which this ranking has been rewarded are as follows:

- Percentage of economic output, the countries devote to R&D investment.
- Scientific and engineering researchers per capita.
- The innovations, measured as patents per capita."

2.7 Replying to a query in writing on the standards/parameters based on which India's ranking was judged as poor, the Ministry stated as under that the reasons for poor ranking are due to:-

a) Lower percentage of economic output the country devotes to R&D investment
b) Lower Scientific and engineering researchers per capita in India.

2.8 On a further query regarding steps taken during the last three years to 'improve' these standards, the Ministry of Mines stated as under:

"The Ministry of Mines had only a supplementary role in improving the standards/ parameters of scientific research. The nodal Ministry for taking action to improve standards is the Ministry of Science & Technology.

NIRM

The steps taken during the last three years to improve these standards are to increase the number of publications in international journals; improving the qualifications/expertise of the existing staff by exposing them to expertise in other institutions in India and through interaction with foreign experts; procuring the state-of-the-art equipment and computer software.

JNARDDC

JNARDDC being a scientific R&D centre is taking all efforts to convince the aluminium industry to increase the investment in R&D sector. The Centre is in constant interaction with the industry. It is also trying to increase the number of publications and patents filed with a view to propagate the benefits of various R&D achievements and as there is a need to commercialize the same for the overall benefit of the industry and the nation as a whole."

2.9 Regarding the ranking in R&D expenditure in the world, a representative of the Ministry of Mines while deposing before the Committee on 16.2.2016 submitted as under:

> "..... Our country stands 30th when we go to the first criteria. I will share some data that I have. India spends only 0.81 per cent of their GDP on R&D. If you compare it with other countries, China spends 2.05 per cent of their GDP. The biggest Country, namely, South Korea spends 4.36 per cent of their GDP on R&D. In fact, when it comes to Global Technology Index, Finland has the top slot in it. US spends 2.7 per cent of the GDP and if I share the numbers, the per capita expenditure of various countries on R&D, this is an information from the internet, South Korea spends $ 1,347 per capita. One more ranking is there, that is, a 2015 Report that is available, which says Global Innovative Index (GII) in which India stands 81 out of 141 countries. There are about 12-13 parameters, which they take to have the ranking in it. There is 'h' index, which connects the patents as per its applicability. So, there are information available in it."

2.10 On the issue of the need for more focus on R&D as compared to other Countries and whether sufficient number of technical specialists, scientist and engineers and adequate resources are available to meet the present requirements and to compete with other countries of the world in R&D sector, the Ministry stated in writing as under:

> "A large number of technical specialists, scientists and engineers join the workforce annually in the Country (as per AICTE, there were 8,56,021 enrollment for the academic year 2015-16 in 3364 engineering and technology Institutes at Undergraduate level and 1,18,201 enrollment for the academic year 2015-16 in 2304 engineering and technology Institutes at Postgraduate level). However, the Country's R&D expenditure (0.88% of GDP on R&D) was lower as compared to that of developed Countries (normally more than 2% of GDP). Also there was wide variation in the facilities and infrastructure available for R&D across various

sectors. Therefore, there was a need to augment R & D by providing more resources in terms of facilities and infrastructure and making R&D jobs attractive for young scientists and professionals. The Country needs to take the lead by laying more emphasis on developing indigenous technologies while learning from international experience. There was a need to have greater institutional collaboration with renowned foreign universities and technology institutions for exposure of Indian scientists. Scientists, faculty & student exchange programmes needs to be promoted. In order to compete with the world, the focus of the R&D should be not only to tackle the present situation but also to cater to the needs for future upcoming technologies.

In the mining and metal sector, the Ministry had a limited role in R&D, which was primarily driven by private sector and PSUs, to meet global challenges in value-added products, technology and cost competitiveness. However, the Ministry promotes R&D in mining-related activities viz. exploration of mineral deposits including deep seated and hidden minerals, extraction of minerals and rock mechanics, ore beneficiation and waste minimization, metallurgy specially in non-ferrous metals, miners' health related issues etc., through its limited budgetary allocation under S&T scheme.

There are three autonomous institutes under the Ministry of Mines viz. NIMH, NIRM and JNARDDC which were carrying out specific R&D activities in their respective fields. These institutions receive partial financial support from the Ministry to meet around 80% of their expenditure and also get funding from research projects sponsored by other sources including private sector. The Ministry's S&T budget was just a small grant and it needs to be enhanced to strengthen infrastructure facilities and capacity of these research institutions for developing indigenous cutting edge technologies in their respective field.

Apart from these, Geological Survey of India (GSI) and Indian Bureau of Mines (IBM) also support R&D and training in their areas of work. GSI had commissioned a state-of-the-art research vessel Samudra Ratnakar and

Heliborne geophysical survey system Garuda Vasudha which had significantly enhanced the capacity for data acquisition and analysis. GSI was also in the process of modernization of its laboratory facilities with the procurement of high resolution chemical analyses instruments, isotope dating facility, seismological geodetic system etc. which was enhancing its capacity for research in the field of geo-science. IBM does important research in ore beneficiation for better recovery of minerals from ores. IBM also guide in sustainable mining practices and restoration of mined up areas which require considerable research activities.

As far as autonomous Institutions were concerned, Jawaharlal Nehru Aluminium Research Development and Design Center (JNARDDC) is the only R&D facility in India carrying out research from bauxite to finished product. As compared to other R&D facilities in the world like Rio Tinto R&D Centre, Automobile Research and Development Centre (ARDC), Canada, The Laboratory of Hydraulics, Hydrology and Glaciology Vereinigte Aluminium-Werke AG, (VAW) Germany, Aluminium Pechiney, France and Suzhou Non-ferrous Research Institute, (SNIR) China (SNIR), China, JNARDDC requires necessary infrastructure and equipments for developing indigenous alumina/aluminium technology including research in energy reduction, environment friendly technologies and indigenization of special utility aluminium alloys for overall development of Indian aluminium sector.

National Institute of Rock Mechanics (NIRM) is an autonomous research institute to aid to the growing needs of the Mining and Civil Construction Industry in the area of Rock Engineering for design and development. The Institute provides research and consultancy support in almost entire spectrum of rock mechanics for improving safety and productivity in the mining and civil engineering sectors at par with international standards. As shallow deposits were exhausting, we had to go for deeper depths to

extract the minerals, thereby facing more strata related problems. With environment restrictions becoming stringent, we need to look for hitherto uneconomical deposits and deposits in remote places, where we have to face complex strata conditions. To deal with the above situations, NIRM needs to carry out R&D in new areas, for which increased government funding was needed.

National Institute of Miners' Health (NIMH) is the only institute of its kind providing services to the mining sector with respect to health of the mine workforce and environmental monitoring. Currently, services for dust monitoring, vibration, noise and illumination measurement were provided. To develop NIMH as state of art centre catering to the comprehensive occupational health research for miners like international organizations working in the field of occupational health, we have to further add services such as drinking water quality, ergonomics assessment and intervention, environmental health impact assessment of mining activities and intervention for prevention of workplace related diseases. The Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) will be implemented by the District Mineral Foundations (DMFs) of the respective districts using the funds accruing to the DMF. Under this scheme, it was envisaged that the expertise available with NIMH may also be drawn upon to design special infrastructure needed to take care of mining related illnesses and diseases.

Though the three autonomous institutes were trying to generate funds on their own, but that was just sufficient to run the institute and not enough to carry out more extensive research. In the past, plan grant was not given to these institutes on a regular basis. There was need to provide plan grant on regular basis for infrastructure up gradation so that these institutes are able to properly channelize their focus on R & D activities. Additionally, timely and regular disbursal of non-plan grant will cater to the operational

and maintenance related needs of these institutes besides meeting salary component of the researchers employed in these institutes. These institutes can be used by Govt. for guided research work which would help India develop technologically in that field.

Science and Technology Scheme of the Ministry also needs to be up scaled allowing researcher or institute to form consortium and undertake research at Technology Readiness Level (TRL) 5 and 6 level while continuing to support researchers as was done presently. These kind of researches would be more fruitful for the growth and development of India. The Ministry was already in the process of consultations with stakeholders to identify the problem areas for specific research."

2.11 On the aspect of Research and Development works undertaken by the Ministry/organization, the Ministry of Mines furnished details on prospecting/exploration of strategic rare and rare earth minerals, research in mining methods including rock mechanics, mine, designing, mining equipment, energy conservation, environmental protection and mine safety. On being asked by the Committee about the major constraints faced during implementation of these R&D works, the Ministry in its written reply stated as under:

"The Ministry of Mines lays great emphasis on proper and efficient utilization of rich mineral resources of the Country, which includes scientific exploration and exploitation. Innovation, R&D and induction of advance technologies were key ingredients in the Ministry's Science and Technology Programme. However, the Ministry has only a supporting or supplementary role to play as the concerned mining and metal processing industries were required to play the primary role in promotion and application of appropriate technologies in their respective fields to remain competitive, cost- effective and sustainable.

The Ministry under its Science & Technology Scheme provides assistance to its autonomous institutions namely Jawaharlal Nehru Aluminum Research Design & Development Centre (JNARDDC), National Institute of Rock Mechanics (NIRM) and National Institute of Miners' Health (NIMH).These institutions carry out specific research activities in consultation with the concerned industries/agencies.

As regards to any specific constraint was faced during implementation of R&D programmes, no institution except Hindustan Copper Limited (HCL) has cited any major constraints. NIRM has reported that occasionally there were delay in site preparation by the user agencies due to their internal issues and also in procuring/fabricating the required equipment/instruments in view of their specialized nature which need to be imported at times. JNARDDC also mentioned that in some cases the implementation of R&D activities gets delayed due to lack of timely delivery of requisite sophisticated and fabricated equipment.

HCL has cited lack of "state-of-the-art" testing facilities in the Country for beneficiation studies of copper ore as one of the major constraints in improving the efficiency of the existing process. HCL also lack in-house talent for R&D activities and has plans to tie up with Non-Ferrous Materials Technology Development Centre (NFTDC), Hyderabad to impart requisite training. IBM, Nagpur were proposing upgradation of existing facilities for beneficiation studies .Mineral Exploration Corporation Limited (MECL) reported lack of adequate infrastructure and manpower as the main constraint faced in implementation of R&D projects."

2.12 On being asked by the Committee about the monitoring mechanism for overseeing these R&D works, the Ministry in its written reply stated as under:

"Presently, under the Ministry's S&T Scheme, the proposals for undertaking R&D programme were invited from various institutions in the form of projects. There is an in-built system for appraising, monitoring, reviewing and recommending the

research proposals, by a team of experts viz. Project Evaluation and Recommendation Committee (PERC), Standing Scientific Advisory Group (SSAG) for final approval and sanction. A system of Peer Group Review had been devised for evaluation of the completed projects which recommends release of the withheld amount of 10% of last installment of funds for the project based on achievement of the desired outcomes."

2.13 On being asked by the Committee as to how new and emerging global technologies are being adopted for the S&T Programmes, the Ministry in its reply stated as under:

"The new and emerging global technologies adopted for the S&T Programmes were as under:

"NIRM

Communication networks, such as the V-SAT are used for direct data transmission from the field to the laboratory; latest computer software are procured and used for faster and accurate analysis of the data. State –of-the-art equipment are available to carry out on-site/lab-testing in rocks.

NIMH

Latest and advanced equipment are used for the analysis of human biological and environmental samples collected during field study.

JNARDDC

JNARDDC has initiated the process to adopt various new and emerging global technologies in the following S&T programs with regard to :-

- Effective distribution of power,
- Effective use of mining resources
- Upgradation in extrusion of aluminium alloys

These processes are further elaborated as below :-

a) “Development of Super Thermal Aluminium (STAL) Conductor for Indian Power Sector”. The project aims to develop super thermal resistant aluminium

conductor (STAL) for high capacity and economical distribution of power. With growing economy and Government's commitment of "Power to All", it is imperative to develop indigenous technology to produce such new generation conductors in the Country. Since this technology will be indigenous it can be transferred to SMEs at a very affordable cost compared to the imported technology.

b) "Development of hard and high temperature refractory material / aggregate from saprolite". The objective of this project is to develop refractory aggregate from saprolite. It is unutilised (waste) material generated during bauxite mining. saprolite is exposed in association with bauxite deposits of Central India, West Coast and Gujarat. Development of technology/product from Saprolite which is cheaper and readily available source as compared to other refractory raw material. The development refractory product from saprolite can be the backbone for existing as well as new bauxite mining industry.

c) "Integrated approach for development of process models and pilot production of aluminium alloy extrudates using porthole dies". The project aims to target SMEs for the technology upgradation in terms of simulation of die design, process models development and process parameters for extrusion of different aluminium alloys."

Chapter-III

R&D by Autonomous Bodies

3.1 The Ministry of Mines have three autonomous bodies, namely, JNARDDC, NIMH and NIRM which partially depend upon plan and non-plan grant from Ministry of Mines. They indulge in the field of Aluminium Research, health and rock mechanics respectively. These three autonomous bodies are partly dependent on the plan and non-plan grants from Government of India and they also cover substantial activities of research through their clientele and associated services. In addition to these three organisations, Ministry of Mines also heads the Governing Body of Non Ferrous Materials Technology Development Centre which is a leading research Centre on specialty metals and materials.

One time capital component for updation of R&D facilities

3.2 The quality of R&D hinges upon availability of state of art research facilities in the country. In the mining sector R&D activities are being pioneered by the three autonomous bodies functioning under Ministry of Mines i.e. Jawaharlal Nehru Research Development & Design Centre, Nagpur National Institute of Miners' Health, Nagpur and National Institute of Rock Mechanics, Kolar. As these Institutions were carrying out R&D related work with obsolete equipment, need was felt to replace the capital equipment which have outlived their life. Since these autonomous bodies are unique from the point of view of the national importance and keeping their core competence in mind, the Ministry modified the S&T Scheme after due evaluation by an impartial and independent agency and considered to add one more component in the Scheme viz "One-Time Grant to the Autonomous Bodies under the Ministry of Mines for Capacity Building". During the year 2014-15, grant to the tune of Rs 13.70 crore was released to these Institutions.

3.3 The details of amount allocated and released to the three institutes during the previous years, under "One Time Grant" is given as under :

(Rs. in crores)

Year	Budget Estimate	Revised Estimate	Expenditure
2013-14	Rs. 0.03	Rs. 0.03	Rs. 0.03
2014-15	Rs.13.70	Rs. 13.70	Rs.13.70
2015-16	Rs.7.70	--	--

As on 10.9.2015

Ministry of Mines accords high priority to R&D and in 2014-15 actual expenditure in R&D activities has been 8.5% of its plan budget.

A. Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC)

3.4 JNARDDC is an autonomous body set up in 1989 as a joint venture of Ministry of Mines and UNDP with a view to provide major R&D support system for the emerging modern aluminium industry in India. The Centre caters to R&D needs of both primary and secondary producers. It has made key contributions in the area of beneficiation, characterisation, and technological evaluation, upgradation of bauxites and reduction of energy consumption and utilisation of residual material such as red mud. Against the sanctioned strength of 61 scientific and administrative staff, currently 47 members are in place.

3.5 The R&D Expenditure during last 3 years (including 2015-16) is provided in the table below. Since it is an R&D Organization, salary of Scientists is also included in the R&D related expenditure.

(`in Lakhs)

Head of Account		2013-14	2014-15	2015-16 (*)
INCOME				
1	Special Plan Grant from the Ministry	1.00	740.00	460.00
2	Plan project Grant from the Ministry	22.88	151.84	479.00
3	Non-Plan Grant-in-Aid from Ministry	360.00	400.00	440.00
4	Income from projects & testing (IR) & AMDF (EBR) : IEBR	252.95	307.14	360.00
Total		**636.83**	**1598.98**	**1739.00**
R&D EXPENDITURE				

1	Expenditure on Pay & Allowances	478.23	528.85	580.00
2	Expenditure on Projects, Admin, etc.	157.45	261.85	970.00
Total		**635.68**	**790.70**	**1550.00**

(*) – target

Achievements of JNARDDC

3.6 Innovative schemes taken up in the last 3 years in general and 2015-16 in particular include *inter-alias*

- Indigenization and development of wrought aluminium alloys for Indian defence.
- Development of Super Thermal Aluminium (STAL) Conductor for Indian Power Sector:
- Development of hard and high temperature refractory material/aggregate from Saprolite
- Development of instrument for measuring liquidus temperature of the smelting cells.
- Process developed for production of low soda (Na_2O) hydrate in Bayer Circuit.
- Developed a suitable process for preparation of low ferric alum and ceramic aggregate from waste or low grade aluminium dross.

3.7 The Institute has completed number of research projects, published papers and above all filed a number of patents in the recent past. A table showing its project and research related activities is provided below:-

YEAR	Projects completed	Ongoing projects	Papers published / presented	Patents filed	Seminars organized
2013-14	8	12	15	1	0
2014-15	7	11	23	3	4
2015-16 (*)	8	12	25	3	2

(*) - projected

Action Plan for promoting in-house R&D

3.8 JNARDDC is diversifying in the areas of energy, environment and alloy development. With a view to promote in-house R&D, the centre is upgrading its state of art facilities and installing new alloy development set up for attending to the needs of the

downstream sector in order to address the needs of automobile sector, building & construction industry & packaging industry.

Jawaharlal Nehru Aluminium Research Development and Design Center (JNARDDC), Nagpur is one of the major Research and Development support system for the emerging modern aluminium industry in India. On a query as to what was the contribution of the mineral sector in the GDP of the country during the last five years and what has been the impact of R&D activities undertaken over the last 5 years to enhance the mineral contribution in the GDP, the Ministry stated that:

> "The contribution of mining and quarrying including coal sector in the GDP at constant price was 2.83% in 2010-11, 2.65% in 2011-12, 2.37% in 2012-13, 2.13% in 2013-14 and 2.39% in 2014-15. However, statistics related to value addition under each segment including R&D is not available.The exact contribution of R&D activities in the mineral output could not be ascertained because contribution of different sectors in GDP measured in terms of gross value added by the sectors as a whole and in the year 2014-15, mining and quarrying has contributed 275,812 (Rs in crore) and Minerals has direct correlation with manufacturing sector and in 2014-15, manufacturing sector contributed 19,87,173 (Rs in crore)."

B. <u>National Institute of Rock Mechanics (NIRM)</u>

3.9 The National Institute of Rock Mechanics was established in 1988 as an autonomous research institute under the administrative control of Ministry of Mines. The main objectives of the Institute are :

- To undertake research in Rock Mechanics under different mining conditions to find solutions.
- To evolve new mining methods to promote productivity, safety and conservation in mines.
- To provide consultancy on charge to mining and other organizations.
- To provide facilities for training of mining students.
- To publish and disseminate the results of research.

3.10 The R&D Expenditure as incurred by NIRM during last 3 years (including 2015-16) is provided in the table below. Since it is a R&D Organisation salary of Scientists is also included in the R&D related expenditure.

(Rs. In lakhs)

Head of Account		**2012-13**	**2013-14**	**2014-15**
INCOME				
1	Special Plan Grant from the Ministry	0.00	505.00	185.00
2	Non-Plan Grant-in-Aid from Ministry	477.00	232.00	543.00
3	Income from projects & testing	555.29	1605.22	791.54
Total		**1032.29**	**2342.22**	**1519.54**
R&D EXPENDITURE				
1	Expenditure on Pay & Allowances	775.78	589.57	757.24
2	Expenditure on Projects, Admin, etc.	446.56	1093.68	652.60
Total		**1222.34**	**1683.25**	**1409.84**

*Target

3.11 As per the information made available to the Committee, the Budget of National Institute of Rock Mechanics (NIRM) in the year 2014-15 was Rs. 14 crore. It has been increased to Rs. 16 crore in the year 2015-16. Similarly, the budget of National Institute of Miners' Health (NIMH) has been increased from Rs. 2.5 crore to Rs. 2.6 crore in the year 2015-16. When the Committee asked about the reasons for such meager increase in the budget of the two Institutes and details of R&D works done by them, the Ministry in its written response stated as under:

> "Ministry of Mines provide 80% of salary component to its autonomous institute and also provide one time capital grant restricted for the 12th plan only further under science and technology scheme they are eligible to submit any project but approval depends after the projects get approved by technical Committees of the Ministry. The one time grant scheme undertaken during the 12th Plan brings in substantial investment in the initial year of the 12thplan for revamping the capital infrastructure and making the capacity of the respective institute to venture into

the area of advance research. As the allocated one time increase is tapering off, it would have an impact on total R&D expenditure incurred by these institute. However, this tapering can be offset by the institutes in-house by way of taking advance research proposals from other stakeholders. A concerted action by the institute in this direction would consolidate the extra budgetary resources leading to larger investment in R&D in subsequent years.

Ministries handholding to these institutes would continue in the form of grants towards salary, towards one time increase till corpus of Rs. 27.05 crores is exhausted and also through the suitable R&D projects approved under the Ministry of Mines Scheme of S&T programme. The budget shown by JNARDDC, NIRM and NIMH in the year 2014-15 and 2015-2016 contain the total fund received by them in 2014-15 and likely to be received in the year 2015-16 from the various projects which they receive from different organization including Ministry of Mines. However, any major increase in the activities of these institutes hinges upon in-house expertise and its utilization by various stakeholders."

Key Achievement of NIRM

3.12 The projects of national importance carried out by the Institute *inter-alia* include:

- Controlled blasting carried out for a canal project near highly industrialized zone for SSNNL, Gujarat, and for Kota Atomic Power Plant.
- Design of controlled blasting for speedy construction of Road Under Bridges (ROBs) to South Western Railways.
- 3-D numerical modeling of Mangdechhu Hydro-electric Project, Bhutan, and for Tehri Pumped Storage Project, Uttarakhand.
- Engineering geological studies for Pranahitha-Chevella Sujala Shravanthi (Telangana) Scheme and Rajasthan Atomic Power Project – Units 7 & 8, Rawatbhata.
- Geophysical resistivity image captured below the Haldia-Barauni oil pipeline of IOCL to identify old mining galleries below.

- In-situ hydrofracturing, deformability and shear tests carried out at Attunli Hydro-electric Project, Arunachal Pradesh and at Wangchhu Project, Bhutan.

Strategy for future

3.13 NIRM is expanding its activities into newer areas, such as oil & gas (for projects related to excavation of large underground caverns for strategic storage of these fuels), metro rails (underground rail tunnels and underground stations) major river-linking projects (irrigation tunnels) and other infrastructure projects.

Centers of Excellence are proposed to be established in core areas of rock mechanics; presently Centre for Testing Services and Centre for Site Characterization have been identified; in future, other Centres like Mining Technology, Excavation engineering, Design & Monitoring and Advanced Rock Mechanics Training will be identified.

C. National Institute of Miners' Health (NIMH)

3.14 The National Institute of Miners' Health was established in 1989 with the mandate to conduct applied research in the field of occupational health and hygiene of workers employed in mining and mineral industry with the vision of 'safe mines and healthy miners', its headquarter is at Nagpur and against the sanctioned 22 posts, currently 18 number of scientists are in place.

R&D Expenditure during last 3 years

Head of Account		**2012-13**	**2013-14**	**2014-15**
INCOME				
1	Special Plan Grant from the Ministry	0.00	01.00	125.00
2	Non-Plan Grant-in-Aid from Ministry	170.00	162.08	150.00
3	Income from projects & testing	115.15	80.49	110.00
	Total	285.15	243.57	385.00
R&D EXPENDITURE				
1	Expenditure on Pay & Allowances	138.84	170.37	162.31
2	Expenditure on Projects, Admin, etc.	97.80	84.13	94.73
	Total	236.64	254.50	257.04

The key initiatives taken by NIMH include the following:-

- Development of standard framework and guidelines for noise mapping in mines and surrounding community.
- Multi Centric Study of dust Related Diseases in Stone Mines and Development of Sustainable Preventive Programme.
- Identification of biomarkers for detection of Noise Induced Hearing Loss in the Miners.
- 9 Research papers have been published in reputed Journals during the year 2014-15 primarily on occupational hazard associated with the mining activities.

Strategy for future

This institute carry out clientele projects on occupational health and industrial hygiene in various mines and mineral based industries as per the demand of the mines/ industries. In these projects research questions are incorporated to facilitate small scale in house R&D activities in addition to providing services to these clients.

3.15 When the Committee asked to state the reasons for allocating only Rs. 7.70 crore in the year 2015-16 for JNARDDC, NIRM and NIMH under “One Time Grant”, while Rs. 13.70 crore was provided in the year 2014-15 under this scheme, the Ministry in its written response submitted as under:

"The Standing Finance Committee (SFC) has approved an expenditure not exceeding Rs. 66.05 crores for the “Science & Technology Programme” Scheme for the 12th Plan period, with a one-time capital component of Rs. 27.05 crores, an R&D component of Rs. 36 crores and an IEC component of Rs. 3 crores.

The details of one-time grant of three Institutes in 12th Plan period are as under:-

	Capital Cost towards purchase of equipment	Modification of existing spaces/creation of new laboratories	Total
JNARDDC, Nagpur	Rs. 16 crore	Nil	Rs.16 crore
NIRM, Karnataka	Rs. 8.30 crore	Rs. 50 lakhs	Rs.8.80 crore
NIMH, Nagpur	Rs. 1.75 crore	Rs. 50 lakhs	Rs.2.25 crore

There are three grant receiving autonomous bodies under the Ministry of Mines, namely, Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC), Nagpur, National Institute of Miners Health (NIMH), Nagpur and National Institute of Rock Mechanics (NIRM), Kolar. The reasons and justifications for proposing this component in this S&T program is that most of the equipment were procured long time back and many of them have not been replaced as they have outlived their life.

This component has fixed outlay of Rs. 27.05 crores to be disbursed in 12th Plan. In 2013-14, the budget was not allocated as per 12th Plan, only 1 lakh of each institutes was allocated. In the financial year 2014-15, it was clubbed of two year i.e. 2013-14 and 2014-15 and budget allocated Rs. 13.70 crores and thereafter in the financial year 2015-16, it is allocated only for one year as per 12th Plan allocation. This is the reason why during financial year 2015-16, funds are allocated less in comparison of 2014-15. With Rs. 21.43 crores already released in the years 12th plan till date, the disbursement under one time grant in the remaining period would further decrease.

D. Non Ferrous Materials Technology Development Centre (NFTDC)

3.16 NFTDC is an autonomous and self-financing R & D institution under the aegis of Ministry of Mines dedicated to the development of advanced materials, innovative processes on the one hand and mechanical design, analysis, electronics, instrumentation and control leading to component and systems development & integration on the other. NFTDC is a unique Technology Centre, in that it is a multi-

disciplinary knowledge domain based institution which enables the centre to undertake complex technology development endeavours as interdisciplinary projects involving both knowledge creation (scientific know-why) and knowledge integration (technical knowhow). NFTDC's uniqueness also stems from its three genetic characteristics, namely (i) self-financing nature, (ii) its multi-disciplinary all executive Human resource and (iii) R & D policy of applied R & D as contract / sponsored research oriented to needs of user agencies.

The institute is entirely executive based with nearly 60 scientists and engineers as staff covering a range of multidisciplinary knowledge domains. In addition, there are visiting scientists and emeritus professors. NFTDC also has an active academic programme in terms of Joint M Tech and PhD in advanced materials, System Engineering and Design with NITs, Universities and IITs and nearly 40 M Tech and PhD students do their thesis in NFTD.

The R&D expenditure incurred by NFTDC is provided in the table below:-

(In Rs. Crore)

NFTDC	FY 2014-15	FY 2013-14	FY 2012-13	FY 2011-12
Revenue Income		14.02	12.89	12.05
Expenditure Including Depreciation		14.76	13.12	11.28
Depreciation		2.22,	1.39	1.43

Key Achievements

3.17 NFTDC is involved in development of advanced materials, components and systems in high technology areas such as (i) aeronautical and aerospace (ii) metallurgical & Process Engineering, (iii) energy (conventional and nonconventional), (iv) automotive, (v) biomedical and health care and (vi) environment sectors. The basic core competence of NFTDC in (a) Design, (b) advanced materials & Manufacturing and (c) Controls and Instrumentation have been integrated in all projects to render technology solutions in an end to end paradigm. NFTDC's systems approach to technology development enables concept to product development spanning Technology

Readiness Levels 3 to 7, thus addressing the real gaps in translational research. Apart from aerospace &automotive, the institute specialized in following fields:

- Rare Earth Materials
- Energy Materials and Devices
- Next Generation alloy conductors for Power Sector
- Advanced Engineering Ceramics from Minerals.

Chapter- IV

R&D by PSUs and Attached & Subordinate Offices

When the Committee enquired about the extent of investments in the R&D in mining sector as a percentage of revenue and how it compares with global standards including initiatives undertaken to boost investment on R&D activities, the Ministry of Mines in its written reply stated as under: -

> "The Indian Mining Sector is fragmented and dominated by large number of players mostly those belonging to private sector. A consolidated figure of R&D expenditure by large number of mining companies / firms / individuals is not available.
>
> However, at macro level according to global competitiveness report 2014-15 India's capacity for innovation in general has been lower than that of many countries like USA, UK, South Korea and even other BRICS countries such as Brazil, China and South Africa. This is also exhibited through poor score on industry collaboration on R&D. In terms of companies spending on R&D in absolute terms and also the ratio is far less in comparisionto advance and emerging countries. In terms of capacity for innovation India Ranks 48, for quality of scientific institution it ranks 52 and for company spending it ranks 30 in the world.
>
> Ministry of Mines accords high priority to R&D and in 2014-15 actual expenditure in R&D activities has been 8.5% of its plan budget.
>
> The PSUs under Ministry of Mines are following the guidelines of Department of Public Enterprises which provides for the minimum amount of expenditure for R&D activities as under:

Sl. No.	Category of CPSE	Minimum Expenditure on R&D as a percentage of PAT
1	Maharatna &Navratna	1% of the Profit after Tax
2	Miniratna – I & II and below	0.5% of the Profit after Tax

A. National Aluminium Company Limited(NALCO)

4.2 National Aluminum Company Limited (NALCO) is a Navratna CPSE under Ministry of Mines, Govt. of India. It was established on 7th January, 1981, with its registered office at Bhubaneswar. The Company is a group 'A' CPSE having integrated and diversified operations in mining, metal and power with sales turnover of Rs 7024

crore in financial year 2013-14. Presently, the Government of India holds 80.93% equity of NALCO.

The company has a 68.25 lakh TPA Bauxite Mine & 22.75 lakh TPA Alumina Refinery located at Damanjodi in Koraput dist. of Odisha, and 4.60 lakh TPA Aluminum Smelter & 1200 MW Captive Power Plant located at Angul, Odisha. As per diversification plan, NALCO has ventured into renewable energy sectors. The Company has successfully commissioned two wind power plants. A 50.4 MW wind power plant at Gandikota, Andhra Pradesh and another of 47.6 MW wind power plant at Jaisalmer, Rajasthan are operational since December, 2012 and January, 2014 respectively. 260 KW Rooftop Solar Power System has been made operational at Office and Township, Bhubaneswar during FY 2014-15.

4.3 R&D Expenditure by NALCO during the last 3 years (including 2015-16) in terms of total turnover, profit/ budget is as under:

2012-13 (Rs. In Crores): Turn Over-Rs. 7247 Crore; PAT: Rs. 593 Crore.

Fund Allocated (Budget)	Fund Utilized/ R&D Expenditure	R&D Exp as % of Turnover/	R&D Exp as % of Profit After Tax (PAT)	R&D Exp as % of PAT of previous year as per DPE guideline.
15.76	18.92	0.26	3.19	2.23
2013-14 (in Rs Crores): Turn Over-Rs 7024 Crore; PAT: Rs 642 Crore				
12.96	13.87	0.20	2.16	2.34
2014-15(in Rs Crores): Rs 7771 Crore; PAT: Rs 1322 Crore				
8.59	7.31	0.09	0.55	1.14

2015-16(in Rs Crores)

Projected Turnover	Projected Expenditure on R&D
9026	13.22

4.4 As per the information made available to the Committee, Rs. 18.92 crore was spent by NALCO in the year 2012-13. This expenditure was 13.87 crore in the year 2013-14 and in the year 2014-15, only Rs. 7.31 crore was spent by NALCO on R&D. On being asked by the Committee about the reasons for lesser expenditure by NALCO on

R&D and the schemes formulated by NALCO to utilize Rs. 13.22 crore in the year 2015-16, the Ministry in its written response stated as under:

"The expenditure incurred during 2012-13, 2013-14, as noted by Hon'ble Members have exceeded the allocation, made based on DPE guidelines. However NALCO fell short by 1.28 crore from allocation during 2014-15. The major reasons for such shortfall are:

Delay in completion of certain in house as well as collaborative projects and the desired success could not be achieved in some projects such as;

(a) 'Tile from Fly Ash Project', in which scaling up of the projects to pilot/ plant scale, as perceived could not taken up

(b) Delay in finalization of R&D agreement with RTA due to various issues, which delayed the expenditure on the account.

However the balance of above R&D allocation shall be added to the expenditure planned in the current years, 2015-16 as per DPE guidelines."

The key initiatives taken include the following:-

- Studies on Solubility of Lime from different sources to establish their suitability as Filter Aid.
- Optimization of synthetic flocculent from different sources for use in High Rate Thickener and Deep Cone Washers for better settling and substitution of natural Flocculent, Wheat Bran.
- A novel process on destruction of toxic Cyanide and recovery of valuables (Sodium, Fluoride etc.) from spent pot lining material (SPL) has been developed and the process knowhow has been commercialized to 2 parties.
- A new method has been developed for extraction of Alumina from fly Ash through Pyro/ Hydro Metallurgical routes.
- Seed Grinder has been introduced in Refinery for control of grain size and maintains liquor productivity.
- Tri Calcium Aluminate has been introduced as filtrate in place of Lime for better through put of Liquor.

- Factors contributing to Melt Loss identified and the same is under implementation to reduce the melt loss.
- Use of Slotted Anodes and anodes with higher stub hole depth in pot lines have been introduced for reduction of energy consumption.

Strategy for future

The main thrusts areas which form the goals and objectives of R&D are:

- Increasing extraction efficiency and productivity to maximize production;
- Reduction in the cost of production of bauxite, power, alumina and aluminum;
- Development of new Aluminum alloys and value added products;
- Waste utilization and disposal and
- Attain analytical excellence along with development of reference standards.

International collaboration:

- NALCO has collaborated with CSIRO, Australia on extraction of Alumina from low grade ore/ fly ash
- NALCO has collaborated with Aluminum Pechiney/Rio Tinto Alcan to take up various developmental R&D Projects.

4.5 NALCO is reported to be in the process of finalizing various R&D projects and facilities that are to be taken up in its R&D centers including NRTC (NALCO Research and Technology Centre). Board level technology Committee and Research and Scientific Advisory Committee (RSAC) meetings are being held periodically to review the R&D activities of the company including technological up gradation and innovative modification carried out in different units and benefits derived thereon for further improvement in the process and productivity and also to review MOU Project.

When the Committee asked to furnish details of the R&D projects finalized by NALCO to be taken up during the current year, the Ministry in its written reply stated as under:

"Details of the R&D projects finalized / to be finalized shortly by NALCO, to be taken up during the current year are as given below:-

I. In-house Projects:

1. Controller System for compressed air in Smelter Plant, as an energy saving tool by optimizing the running of compressors has been undertaken. Tendering activity for the procurement and installation of the system is in progress.

2. For large scale plant trial of the project “Improvement in oxidation behavior of anodes- action has been initiated. Bench scale trial results to improve anode quality for trial & implementation.

3. Trial of Synthetic flocculent in washers at Alumina Refinery as a suitable replacement of natural flocculent.

II. Collaborative Projects in pipeline:

Sl. No.	Proposal in Brief	Agency
1	Up-gradation of Pot in Smelter with high amperage for increase in current efficiency and productivity.	RTA Alcan
2	Recovery of alumina and titania from red mud through hydrometallurgical route.	IMMT
3	Defluoridation of Smelter surface water through EMRION Technology.	Eesavyassa
4	Development of NALCO alumina nano-fluid: a cost effective formulation and study of its stability.	GIFT, Bhubaneswar
5	Development of electronic material for device fabrication using NALCO red mud	Sikhsa-o-Anushandhan University and GIFT combined
6	Project on Development & implementation of specialized energy saving motors in generators, wind mills, conveyors, agitators etc	Eesavyasa Technology, Hyderabad
7	Extraction of gallium from aluminium waste in plant scale.	BARC, Mumbai
8	Fabrication and commercialization of a highly porous pervious concrete material from fly ash.	KIIT University, Bhubaneswar
9	Embedded system for compressed air consumption monitoring in aluminium smelter plant.	NIT, Rourkela
10	Pilot scale trial of “DC electric degassing process’ for molten aluminium/alloys	NML, Jamshedpur
11	Multi scale modeling and prediction of microstructure for processing of Al-Li alloys for structural applications.	IIT, Kgp& KIST, Bhubaneswar

All the above projects will be taken up for a period of 2-3 years with an investment of about Rs 35-40 crore."

B. Hindustan Copper Limited (HCL)

4.6 Hindustan Copper Limited (HCL), a public sector undertaking under the administrative control of the Ministry of Mines, was incorporated on 9th November 1967. It has the distinction of being the nation's only vertically integrated copper producing company as it manufactures copper right from the stage of mining to beneficiation, smelting, refining and casting of refined copper metal into downstream saleable products.

The Company markets copper cathodes, copper wire bar, continuous cast copper rod and by-products, such as anode slime (containing gold, silver, etc.), copper sulphate and sulphuric acid. More than 90% of the sales revenue is from cathode and continuous cast copper rods. HCL's mines and plants are spread across four operating Units, one each in the States of Rajasthan, Madhya Pradesh, Jharkhand and Maharashtra

4.7 The total sanctioned number of posts of scientists in HCL is 25. All are working in R&D.

R&D Expenditure during last three years (including 2015-16) in terms of total turnover and profit/budget are as follows:-

Period	R&D expenditure (in Crore)	% R&D expenditure w.r.t turnover	% R&D expenditure w.r.t PAT
2013-14	3.068	0.19	1.07
2014-15	2.85	0.25	4.19
2015-16	2.34	0.47 (prov)	7.0 (prov)

4.8 The key initiatives taken by HCL, as under:

- Rock mechanics study of underground mines to improve safety.
- Subsidence study of Khetri Copper Mine &Kolihan Copper mine at Rajasthan.

- Trial run of 90mm high chrome grinding media for lowering spillage generation and obtaining higher % of fines.
- Study of utilization of copper slag in cement Industry.
- Test work & desktop study for recovery of LME-A grade copper from the copper concentrate through hydrometallurgical route.
- Mineral processing test work of copper ore.
- Recovery of valuable metals and mineral from copper ore tails (waste) at Rajasthan
- Recovery of nickel salts/ nickel from the spent electrolyte of copper refinery.
- Replacement of high pressure burner with low pressure burner at Smelter plant, Jharkhand.
- Bench scale pilot study of copper recovery of sulphide concentrates through hydrometallurgical route.

Strategy for future

- Human resource building for R&D by additional recruitment and training.
- Strengthening of R&D infrastructure and enhancement of funding.

During the year 2015-16, HCL has spent an amount of Rs 275.0 lakhs on purchase of R&D equipment which is 48% of the total expenditure on R&D by the Company. During 2014-15 & 2013-14, the amount spent on equipment is Rs 6.97 & 6.25 lakh respectively which is 2.5 & 2.1 percent of the total R&D expenditure amount respectively."

C. Mineral Exploration Corporation Limited (MECL)

4.9 MECL functioning under Ministry of Mines, Government of India, is a premier exploration agency in the country engaged in detailed mineral exploration for various minerals such as Coal, Lignite, Copper, Lead, Zinc, Gold, Iron Ore, Lime Stone, and Bauxite etc. except Oil & Natural Gas.

MECL projects are executed as promotional exploration for Ministry of Mines and Ministry of Coal and contractual work for Central / State Governments, PSUs and

Private Sectors. MECL's Geological Report forms the basis for Planning and Development of Mines.

4.10 R&D expenditure of MECL during last three years and 2015-16 are as under:

(Value in Rs. lakhs)

Financial Year	Expenditure on R&D	Gross Revenue	Profit After Tax
2012-13	15.73	17168	2067
2013-14	29.95	19856	2546
2014-15	39.33	27557	5944

The key initiatives taken in R&D activities in the field of geophysics

4.11 MECL has identified the limitation of a single method of Surface Geophysical survey technique due to complicated Geological set up. Research and Development Projects have been conceived with a basic objective to establish an integrated method of different techniques which can be fruitfully adapted for exploration of any type of Sulphide ore deposit such as massive/ disseminated and map their subsurface disposition, continuation and structural features in comparatively lesser time as well as at lesser cost.Under the scheme of R&D work, all the projects were formulated with the help of National Geophysical Research Institute (NGRI), Hyderabad.

The key initiatives taken in R&D activities in the field of drilling

4.12 The aim of research activities undertaken was to improve the quality of drilling activity by enhancing the time available for drilling and reducing the wear and tear of mud pumps, cutting tools, barrels and drill rods.

4.13 There are no such sanctioned posts of Scientists /Engineers for R&D in MECL. The Scientists and Engineers in MECL carry out R&D work as and when required.

MECL has started recruiting Scientists & Engineers on regular basis from the last 3 years. After fulfilling the demand of regular post of Scientists & Engineers, MECL may deploy a team of newly recruited Scientist & Engineers dedicated for R&D work in mineral exploration.

R&D by Attached & Subordinate Offices

A. Geological Survey of India(GSI)

4.14 The Geological Survey of India (GSI) was set up in 1851 primarily to find coal deposits for the Railways. Over the years, it has not only grown into a repository of geo-science information required in various fields in the country, but has also attained the status of a geoscientific organisation of international repute. The main functions of GSI relate to creation and updation of national geoscientific information and mineral resource assessment. These objectives are achieved through ground surveys, air-borne and marine surveys, mineral prospecting and investigations, multidisciplinary geo-scientist, geo-technical, geo-environmental and natural hazards studies, glaciology, seismotectonics, and carrying out fundamental research.

GSI, headquartered at Kolkata, has six Regional offices located at Lucknow, Jaipur, Nagpur, and Hyderabad, Shillong and Kolkata and State Unit offices in almost all States of the Country. Presently, Geological Survey of India is an attached office to the Ministry of Mines.

R& D Expenditure in GSI

4.15 The R & D expenditure in GSI incurred in last three years and current year are as follows.

(In crores)

Year	Budget	Actual Expenditure
2013-14	8.33	8.25
2014-15	12.91	12.56
2015-16 (upto March 2016)	11.8	11.72

The key initiatives taken in R&D activities

4.16 Research and Development in GSI is in the field of assessment of mineral resources, characterization of ore mineralization and understanding of genesis of minerals. The main R&D areas are-

- GSI's main focus is to establish subsurface behavior of the mineralization, tonnage and methodology to obtain best yield of concerned commodity. The three National Centers for Geoscience Research (NCEGR) of GSI situated at Kolkata, Bengaluru and Faridabad are engaged in research on mineral characterization and ore beneficiation.
- GSI has taken up research projects on Platinoid Group of Elements (PGE) Exploration, Polymetallic minerals, coal, gold exploration etc.
- Another area of research related to the exploration of minerals is National Geochemical Mapping (NGCM).
- New concept oriented approach in the form of Hyper Spectral Mapping has been initiated to understand the nature of ore deposit and alteration pattern.
- The State-of-the-art scientific vessel R.V. Samudra Ratnakar has been procured by GSI in 2013 having 27 scientific equipment fitted on-board for geological, geophysical and geochemical exploration of the sea bed for establishment off shore marine mineral resource and research in Exclusive Economic Zone (EEZ) of India.

Strategy for future

The emphasis of R & D is to be on mineral beneficiation for the samples of gold investigation, base metal investigations, tin-tungsten-copper investigation, Iron ore investigation, PGE investigation & Andalusite investigation. The other areas identified for R&D activities are -

- Glauconitic sandstones and shales are to be studied thoroughly from the point of view their direct utilisation in the fertilizer industry.
- Tracking down the sources of high REE bearing rocks, the mineral phases responsible for enrichment of REE in the endogenic host rocks and availability of technology for separation.

Strategy for future

4.17 Fundamental Research & Development activities in GSI are carried under Mission-IV. In so far as R&D in mining Sector is concerned, R&D of GSI is restricted to assessment of mineral resources, characterization of ore mineralization and understanding of genesis of minerals which has long term impact on the mining sector for understanding the nature of the mineral deposits.

In various fundamental research projects of GSI, tentatively 86 Geologists, 6 Geophysicists and one chemist are engaged during the current Field Season programme i.e. Field Season (FS) 2015-16. During Field Season (FS) 2014-15, 64 Geologists and one Geophysicist and in Field Season (FS) 2013-14, 44 Geologists and 3 geophysicists were engaged in different fundamental research projects of GSI.

There is no separate sanctioned post of Geologist/ Geophysicist/Chemist for R&D work. The total sanctioned strength and filled strength of Science & Technology (S&T) stream of GSI as on 31.01.2016 is as given below:

Status of Sanctioned & Filled Strength of S&T streams in GSI as on 31.01.2016

	Stream	Sanctioned strength				Filled strength			
		Gr. A	Gr. B (including NG)	Gr. C	Total	Gr. A	Gr. B (including NG)	Gr. C	Total
S&T (a)	Geology	2786	660	150	3596	1893	136	81	2110
	Geophysics	555	220	70	845	224	216	34	474
	Chemistry	509	315	150	974	152	117	83	352
	Engineering	90	416	744	1250	55	190	285	530
	Total (a)	3940	1611	1114	6665	2324	659	483	3466

As per the perspective plan of GSI the recruitment for the vacant posts in Science & Technology streams are being done to achieve the sanctioned strength of GSI.

4.18 R&D expenditure in GSI incurred during last three years (FY. 2013-14, 2014-15 and 2015-16 till September 2015) were as follows:-

(Rs. In crores)

	2013-14			2014-15			2015-16	
Schemes	BE Grant	RE	Actual Exp.	BE Grant	RE	Actual Exp.	BE	Actual Exp. (upto Sept. 2015)
Research & Development	8.33	8.33	8.25	25.89	12.91	12.56	12.63	6.59

As regards the reason for reduction from BE of Rs.25.89 crore in 2014-15 to Rs.12.91 crore at RE stage, the Ministry in its written response stated as under:

"GSI was allocated a BE Grant of Rs. 25.89 crores during FY 2014-15 under R & D scheme. A major portion of this grant was under supply & material head. This was intended to be used for procurement of number of instruments required for various laboratories of GSI. However, many of these instruments were procured from the funds allotted under Machinery & Equipment head since a certain amount was available under the Machinery and Equipment head. This was due to the fact that the GTV project of GSI had not materialized in the F.Y. 2014-15. Therefore, there was a reduction at RE stage."

B. <u>Indian Bureau of Mines (IBM)</u>

4.19 The Indian Bureau of Mines (IBM) is a subordinate office under the Ministry of Mines. It is engaged in the promotion of scientific development of mineral resources of the country, conservation of minerals, protection of environment in mines, other than coal, petroleum and natural gas, atomic minerals and minor minerals. It discharges regulatory functions with respect to the relevant provisions of Mines and Minerals (Development and Regulation) Act, 1957 and enforcement of the rules framed thereunder namely Mineral Conservation and Development Rules, 1988, Mineral Concession Rules, 1960, Environmental (Protection) Act, 1986 and Rules made thereunder. IBM undertakes scientific, techno-economic, research oriented studies in

various aspects of mining, geological studies, ore beneficiation and environmental studies.

R&D Expenditure

4.20 The R&D investments in IBM are mainly through its ore dressing window. The details of the expenditure on R&D by IBM are provided below:

(Rs. In crores)

Sl.No	Year	BE	RE	Actual Expenditure
1	2013-14	6.33	5.91	5.56
2	2014-15	6.80	6.56	5.78
3	2015-16	7.31	7.45	7.08 (up to March 2016)

The key initiatives taken include the following:-

The R&D activities are carried out through IBM's Scheme No. 2 namely "Mineral beneficiation Studies - Utilization of Low grade and Sub-grade ores and analysis of Environmental samples". The activities inter alia cover:

- Development of process flow sheet/process know-how by testing on batch laboratory and continuous pilot plant scale on low grade, ferrous, non-ferrous and precious metal ores as well as industrial minerals.
- Preparations of techno-economic pre-feasibility reports for beneficiation of low-grade ores Establishment of process flow sheet and design parameters for commercial concentrators. Development of process parameters for agglomeration.
- Environmental analysis of mine rejects/wastes beneficiations plant effluents/tailings etc. by utilizing instruments like Ion Chromatograph.
- Characterization/Mineralogical studies on ores, rocks, sinters, slags etc. with the help of Microscopic techniques, X-ray Diffraction (XRD) studies, TG/DTA Thermo Analyzer, DTA Equipments."

Strategy for future

Directed consortia research in mission mode in collaboration with institutionsand industry in areas such as Mining Equipment Design, Development and Engineering, Energy Efficient Mining Solutions, Mine/mineral waste management, New and innovative and energy efficient Mineral & Metal processing Technologies, etc.

Initiating Training Programmes on Chemical Analysis and Ore Dressing at Modern Mineral Processing Laboratory and Pilot, IBM office, Nagpur.

4.21 One of the major developmental function of IBM is to play a role of a catalytic agency to promote and develop the much needed R&D in mineral processing in the field of mineral beneficiation, mineral characterization, chemical analysis of ores and minerals and analysis of environmental samples. When asked by the Committee to furnish details of the steps taken by IBM in promotion and development of research and development projects in the mining sector during the last 5 years, the Ministry in its written response stated as under:

> "Mineral Processing (Erstwhile Ore Dressing) Division of IBM carries out R&D studies in the field of mineral beneficiation. It's Modern Mineral Processing Laboratory (MMPL) and Pilot Plant comprising of Ore Dressing Laboratory, Mineral Beneficiation Pilot Plant, and Analytical Laboratory Complex established with the assistance of UNDP is well equipped with state-of-the-art facilities to carry out R&D studies in the field of mineral beneficiation and mineral characterization, and analysis of environmental samples. The Bureau has zone-wise facilities in mineral testing and beneficiation with regional ore dressing laboratory and pilot plants at Ajmer and Bangalore which are also well equipped with sophisticated equipment. A 'Clay Laboratory' has also been established to cater to the needs of the north-eastern region exclusively. The Mineral Processing Division of IBM conducts mineral beneficiation investigations, chemical and mineralogical studies, both on promotional as well as on charge basis. This supports the small mine owners on one hand and mineral beneficiation trouble shooting for all mines.

Important steps taken by IBM in promotion and development of research and development projects in the mining sector during the last 5 years include the following :

(i) Development of process flow sheets for upgradation of ores and minerals other than coal and atomic minerals with a view to conservation of ores and minerals other than coal and atomic minerals for conservation and mineral growth.

(ii) Amenability studies for beneficiation of samples collected through Regional Mining Geologist Studies (RMGS) and Regional Mineral Development Studies (RMDS) aimed at promotion and development in the mining sector towards compliance of regulatory functions of IBM for systematic and scientific mining.

(iii) Conducting studies such as process mineralogy, analytical and physical characterization and beneficiation of waste dumps, mineral rejects, sub grade mineral stocks for implementation of zero waste mining and sustainable growth.

(iv) Beneficiation studies aimed at suggesting blending options for effective utilization of waste dumps/low grade ores for mineral conservation and sustainable growth.

(v) Recovery of metal values and valuable by-products from tailing waste dumps.

(vi) Beneficiation studies for utilization of ors and minerals which are even below the threshold value of minerals as notified by IBM.

(vii) Publications – (1) Iron and Steel Vision 2020 and (2) Monograph on Manganese Ore.

(viii) Mineral Beneficiation studies on samples received from exploratory agencies like GSI, MECL etc.

Part -II

Observations/ Recommendations

R&D in Mining Related Activities

1. The Committee note that in the mining and metal sector, the Ministry of Mines have a limited role in Research and Development (R&D) activities which is primarily driven by private sector and Public Sector Undertakings (PSUs), mainly for the purpose of development of value-added products, technology upgradation and cost competitiveness. However, the Ministry promotes R&D in mining-related activities viz. exploration of mineral deposits including deep seated and hidden minerals, extraction of minerals and rock mechanics, ore beneficiation and waste minimization metallurgy specially in non-ferrous metals, miners' health related issues etc. through its limited budgetary allocation under Science and Technology (S&T) scheme. In this context, the Committee find that the National Mineral Policy, 2008 recognizes the paramount importance of safety, economy, speed and efficiency in extraction of ore resources and its convergence into viable economic alloy and metals and has accorded higher priority to Research and Development (R&D) programmes. The Committee are happy to note that the Ministry of Mines has launched a comprehensive Science and Technology Programme inclusive of three main components *viz.* Research and Development (R&D); Information Education and Communication (IEC); and One-time Capital Component for up-gradation of R&D facilities in three autonomous bodies i.e. Jawaharlal Nehru Research Development and Design

Centre (JNRADDC), National Institute of Miners' Health (NIMH) and National Institute of Rock Mechanics (NIRM). Besides, the three Mining PSUs *viz.* National Aluminum Company Ltd. (NALCO), Hindustan Copper Limited (HCL) and Mineral Exploration Corporation Limited (MECL) as well as attached office of Geological Survey of India (GSI) and subordinate office of Indian Bureau of Mines (IBM) also contribute to R&D sector. The Committee are happy to note that in order to fructify the principles enunciated in the National Mineral Policy, guidelines for support to 'Mining Research' were issued in May, 2013 which set forth the objectives and thrust areas of research and sought to provide renewed scientific impetus to address the emerging mining challenges. The Committee hope that earnest efforts will be made by the various bodies involved in R&D in the Mining Sector so that tangible results are achieved from these initiatives. To these extent, the Committee desire the Ministry to set clear targets to achieve the objectives as set out in the vision document within a broad timeframe. The Committee expect that the tangible results from all these R&D Programme foster greater utilization of the available mineral resources judiciously, economically and efficiently in an environmentally sustainable manner.

<u>Science & Technology Programme in Mining Sector</u>

2. The Committee note that there has been a quantum jump in the allocation of funds for Science and Technology Programme as evident in the Budget Estimates (BE) 2013-14 standing at Rs. 3.97 crore with expenditure of Rs. 1.97 crore which was increased to Rs. 6.60 crore in the Budget Estimates 2014-15 with 100% utilization of the funds. The BE 2015-16 was further increased to Rs. 7.30

crore. Admittedly, the scheme has become more broad based with the participation of a large number of Research Institutes and in the year 2015-16, 86 research proposals were received in the Ministry and are reported to be awaiting clearance as compared to the 16 approved projects for the year 2014-15. The Committee observe that the Research Programme supported by the Ministry include important components pertaining to prospecting/exploration of strategic rare metals and rare earth minerals; Research in Mining Methods including rock mechanics, mine designing, energy conservation, environmental protection and mine safety, and Mineral Beneficiation Techniques to utilize lower grade minerals and for quality improvement. Keeping in view the importance of R&D in the Mining Sector, the Committee feel that the Ministry's endeavour to synergise all the initiatives on these fronts would result in maximizing R&D outcomes. The Committee also stress on the need of putting into place an effective coordinating and monitoring mechanisms at a distinctly higher level in the hierarchy not only for achievement of targets set out in the National Mineral Policy, 2008 but also for ensuring effective utilization of R&D results to boost efficient, economic and safe mining activities in the country. The Committee would like to be apprised of the action taken by the Government in this regard. The Committee would also like to be apprised of the outcome of 16 R&D projects approved during 2014-15 and the present status of 86 Research Projects received during 2015-16.

Global Ranking in R&D

3. The Committee find that in R&D sector at the international level, India is ranked at 48th in capacity innovation, 52nd in scientific institution and 30th in

R&D expenditure in the World. While observing that the parameters taken into consideration for ranking were percentage of economic output devoted to R&D investment, scientific and engineering researchers per capita and innovations measured as patents per capita, the Committee note that India's poor ranking was mainly on account of lower percentage economic output devoted to R&D investment and lower scientific and engineering researchers per capita. The Committee feel unhappy to find that India spends a meager only 0.81 percent of their GDP on R&D as compared to 2.05 percent by China, 4.36 percent by South Korea and 2.7 percent by USA. Further, India stands at a lowly 81 out of 141 countries in the Global Innovative Index. The Committee, therefore, are of the considered opinion that there is an imperative need to boost the R&D infrastructure across various sectors by allocation of more funds for R&D resources; making R&D jobs attractive to young talented scientists and professionals; greater institutional collaboration with renowned foreign universities/technology institutes; focus on future upcoming technologies to meet global challenges in value-added products, technology and cost competitiveness and development of indigenous cutting edge technologies.

4. The Committee also note that the Indian Mining Sector is fragmented and dominated by a large number of players mostly belonging to the private sector. India's capacity for innovation is far lower than that of many countries like USA, UK, South Korea and even other BRICS countries such as Brazil, China and South Africa as per the Global Competitiveness Report 2014-15. This is also

evident in the poor score on industry collaboration on R&D. The Committee have been apprised that the Ministry of Mines has only a supplementary role in improving the standard parameters of scientific research and the nodal Ministry responsible for taking action to improve R&D standards is the Ministry of Science & Technology. The Committee are, therefore, of the firm view that to sustain and improve the competitiveness of India's Mining Sector, adoption of modern and state-of-the-art technologies both in existing and new plants is required by pursuing appropriate R&D programmes. The Committee, therefore, desire that a holistic approach encompassing the various aspects of shortcomings affecting the Indian R&D sector in mining should be followed besides bringing out a roadmap towards tackling the ground level impediments and constraints. The Committee further desire the Ministry of Mines to make sustained efforts in coordination with Ministry of Science and Technology to raise India's low ranking in R&D at the international fora. The Committee would like to be apprised of the action taken by the Govt. in this regard.

R&D by Autonomous Bodies of Ministry of Mines

5. The Committee note that there are three grant receiving autonomous bodies under the Ministry of Mines, namely, Jawaharlal Nehru Aluminum Research Development and Design Centre (JNARDDC); Nagpur, National Institute of Rock Mechanics (NIRM), Kolar and National Institute of Miners' Health (NIMH), Nagpur which are pioneering the R&D activities in the Mining Sector under the Science & Technology (S&T) Scheme of Ministry of Mines. These institutions receive partial financial support from the Ministry to meet around 80% of their expenditure and

also get funding from research projects sponsored by other sources including private sector. At the same time, the Committee note that these Institutions were carrying out the R&D related work with obsolete equipment and a need was felt to replace the capital equipment which have outlived their life. Since these bodies are unique from the view of national importance and keeping their core competence in mind, the Ministry modified the S&T Scheme and considered to add one more component in the Scheme namely 'One Time Grant for Capacity Building' and grant to the tune of Rs. 13.70 crore was released to these Institutions during the year 2014-15. Additionally, timely and regular disbursal of non-plan grant will cater to the operational and maintenance related needs of these institutes besides meeting salary component of the researchers employed in these institutes. The Committee further note that though the three autonomous institutes are trying to generate funds on their own, the fact remain that the same is just sufficient to run the institute and not enough to carry out more extensive research. In the past, plan grant was not given to these institutes on a regular basis. The Committee observe that plan grant on a regular basis for infrastructure upgradation is needed so that these institutes are able to properly channelize their focus on R&D activities. The Committee feel that these institutes can be used by Government for guided research work to help the Country to develop technologically. While observing that Ministry's S&T budget is just a small grant, the Committee recommend that it needs to be enhanced in order to strengthen to the infrastructure facilities and capacity of these research institutions for developing indigenous cutting edge technologies in their respective field.

6. The Committee have been apprised that Science and Technology Scheme of the Ministry also needs to be up scaled allowing researcher or institute to form consortium and undertake research at Technology Readiness Level (TRL) 5 and 6 level while continuing support to the researchers. Admittedly, the Ministry was already in the process of consultations with stakeholders to identify problem areas for specific research. The Committee desire that the Mining Sector need to focus on R&D for better resource utilization, better cost efficiency and production of world class products. The Committee may be apprised of the sustained efforts made by the Ministry of Mines/ PSUs and Autonomous bodies to undertake research covering various aspects *viz.* ore beneficiation for better recovery of mineral from ores; developing indigenous cutting edge technologies in their respective field; exploration of mineral reserves including deep seated and hidden minerals; extraction of minerals and rock mechanics; minimization metallurgy specially in non-ferous metals miners' health related issues; etc. The Committee, therefore, recommend that the Government should take necessary steps so that the pace of R&D activities gains adequate momentum to sustain a high growth in mineral exploration and extraction. The Committee would like to be apprised of the action plan of the Government to bring the mine exploration and extraction in the Country to international standards in the near future.

Jawaharlal Nehru Aluminum Research Development and Design Centre (JNARDDC)

7. The Committee find that R&D by Autonomous Bodies under the Ministry of Mines partially depend upon plan and non-plan grant from the Ministry and these Bodies also cover substantial activities of research through their clientele and

associated services. The Committee observe a considerable increase in R&D expenditure from Rs. 635.68 lakhs in 2013-14 to Rs. 1550.00 lakhs in 2015-16 by JNARDDC. Further, 23 projects during the year 2013-14 to 2015-16 were completed by JNARDDC and 35 projects were reported to be under implementation. The Ministry of Mines extends all possible support to JNARDDC for fulfilling its requirement of necessary infrastructure and equipment for development indigenous alumina/aluminum technology including research in energy reduction, environment friendly technologies and indigenization of special utility aluminum alloys for overall development of Indian aluminum sector. Admittedly, JNARDDC not only provides a major R&D support system for the emerging modern aluminum industry in India but also caters to R&D needs of both primary and secondary producers. The Committee also note that JNARDDC has made key contributions in the area of beneficiation, characterization and technological evaluation, up-gradation of bauxite and reduction of energy consumption and utilization of residual material such as red mud. The Committee appreciate the research work undertaken by JNARDDC during the last 3 years which *inter-alia* include indigenization and development of wrought aluminum alloys for defence, development of Super Thermal Aluminum (STAL) conductor for Power Sector, Development of hard and high temperature refractory material/aggregate from Saprolite, Development of instrument for measuring liquidus temperature of the smelting cells, Process developed for production of low soda (Na_2O) hydrate in Bayer Circuit, Development of a suitable process for preparation of low ferric alum and ceramic aggregate from waste or low grade

aluminum dross, etc. While appreciating the JNARDDC for promoting in-house R&D, the Committee desire that attention should also be paid for completion of the ongoing schemes like upgradation of its state-of-art facilities and installation of new alloy development set up for attending to the needs of the downstream sectors like automobile sector, building and construction industry and packaging industry. The Committee would also like to be apprised of the steps taken to ensure commercial use of the outcomes of various R&D projects implemented by mine PSUs and Private Sector Mining Companies.

National Institute of Rock Mechanics (NIRM)

8. The Committee note that NIRM is an autonomous research institute providing research and consultancy support in almost entire spectrum of rock mechanics for improving safety and productivity in the mining and civil engineering sectors at par with international standards. The Committee also observe that R&D expenditure of NIRM during 2012-13, 2013-14 and 2014-15 was Rs. 1222.34 lakh, Rs. 1683.25 lakh and 1409.84 lakh respectively. Admittedly, NIRM is expanding its activities into newer areas, such as oil & gas, metro rails, major river-linking projects and other infrastructure projects. Centers of Excellence are proposed to be established in core areas of rock mechanics. Presently, Centre for Testing Services and Centre for Site Characterization have been identified. In future, other Centers like Mining Technology, Excavation engineering, Design & Monitoring and Advanced Rock Mechanics Training will be identified. NIRM has reported that occasionally there was delay in site preparation by the user agencies due to their internal issues and also in procuring/fabricating

the required equipment/instruments in view of their specialized nature which need to be imported at times. The Committee were also given to understand that as shallow deposits were exhausting, one has to go for deeper depths to extract the minerals, thereby facing more strata related problems. With environment restrictions becoming stringent, NIRM needs to look for hitherto uneconomical deposits and deposits in remote places, where one has to face complex strata conditions. The Committee feel that to deal with the above situations, NIRM needs to carryout R&D in new areas, for which increased Government funding is needed. In view of the foregoing, the Committee recommend that not only the Government should grant more funds to NIRM to carryout R&D in new areas but the NIRM should also make earnest efforts to successfully implement their projects/schemes in these new areas.

National Institute of Miners' Health (NIMH)

9. The Committee note that National Institute of Miners' Health was established with the mandate to conduct applied research in the field of occupational health and hygiene of workers employed in mining and mineral industry with the vision of 'safe mines and healthy miners'. The R&D expenditure of NIMH during 2012-13, 2013-14 and 2014-15 were Rs. 236.64 lakh, Rs. 254.50 lakh and 257.04 lakh respectively. The Committee observe that the key initiatives taken up by NIMH inter-alia include development of standard framework and guidelines for noise mapping in mines and surrounding community; Multi Centric Study of dust Related Diseases in Stone Mines and Development of Sustainable

Preventive Programme; Identification of biomarkers for detection of Noise Induced Hearing Loss in the Miners; etc. While expecting that latest and advanced equipment are used by NIMH to analyse the human biological and environmental samples collected during field study, the Committee would like to be apprised of the mechanism with NIMH/Ministry of Mines to monitor that the recommendations of NIMH are implemented by all mining companies so that these initiatives fructify into tangible benefits.

10. According to NIM,H to develop the institute as a state-of-art centre catering to the comprehensive occupational health research for miners like international organizations working in the field of occupational health, there is a need to further add services such as drinking water quality, ergonomics assessment and intervention, environmental health impact assessment of mining activities and intervention for prevention of workplace related diseases. The Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) will be implemented by the District Mineral Foundations (DMFs) of the respective districts using the funds accruing to the DMF. Under this scheme, it was envisaged that the expertise available with NIMH may also be drawn upon to design special infrastructure needed to take care of mining related illnesses and diseases. The Committee would like to be apprised of the perspective plan of Ministry of Mines/NIMH to implement the same.

R&D by PSUs

National Aluminium Company Limited (NALCO)

11. The Committee note that expenditure on R&D by NALCO during 2012-13 was Rs. 18.92 crore which came down to Rs. 13.87 crore during 2013-14 and was further reduced to Rs. 7.31 crore during 2014-15. During 2015-16, the projected expenditure on R&D has been Rs. 13.22 crore. The Committee also note that as a part of its International Collaboration Strategy, NALCO has collaborated with CSIRO, Australia, on extraction of Alumina from low grade ore/fly ash and also collaborated with Aluminum Pechiney/Rio Tinto Alcan to take up various developmental R&D projects. As regards the major achievements of the Company in R&D, the Committee are happy to note that NALCO has so far filed 27 patent applications and 9 (nine) patents, have already been granted and 5 (five) have been commercialized and 1 (one) patent has been filed in 2015-16 on the process for the production of alumina with additional recovery of calcium silicate from fly ash. The Committee are concerned to note that though the Profit After Tax (PAT) of the company, increased from Rs. 642 crore during 2013-14 to Rs. 1322 crore during 2014-15, there was a reduction in R&D expenditure from 2.16% of PAT to 0.55% of PAT during the two years. The Committee note that as a part of R&D initiative, NALCO has undertaken works like prospecting/exploration of strategic rare metals and rare earth minerals, research in mining methods including rock mechanics, mine designing mining equipment, energy, conservation, environment protection and mine safety etc.The Committee appreciate the concerted efforts made towards completion of R&D activities by

NALCO and desire that NALCO should augment steps towards ensuring full utilization of allotted funds for R&D Projects with a systemic periodical assessment mechanism. To this end, the Committee feel that NALCO should set up a separate centre for R&D activities and research facilities with requisite diagnostic and research facilities, pilot plants and simulation facilities. The Committee also desire that the Company should take necessary steps to ensure minimum allocation of 1% of its PAT for R&D activities and would like to be apprised of the perspective plan of NALCO to increase its R&D expenditure as well as tangible outcomes from its R&D projects.

Hindustan Copper Limited (HCL)

12. The Committee note that R&D expenditure of Hindustan Copper Ltd. was Rs. 3.068 crore during 2013-14 and it was reduced to Rs. 2.34 crore during the year 2015-16. In spite of reduced budgetary outlays for R&D by HCL, the R&D expenditure with respect to Profit After Tax (PAT) has increased from 1.07% in 2013-14 to 7.0% during 2015-16. The Committee were apprised of the various R&D initiatives/studies undertaken by HCL like utilization of copper slag in cement industry, mineral processing test work of copper, recovery of valuable metals from copper waste, etc. The Committee, however, observe that HCL has cited lack of "state-of-the-art" testing facilities in the Country for beneficiation studies of copper ore as one of the major constraints in improving the efficiency of the existing process. The Committee also note that HCL lacks in-house talent for R&D activities and has plans to tie up with Non-Ferrous Materials Technology Development Centre (NFTDC), Hyderabad to impart requisite training. While

stressing the need for infusing more funds for R&D activities by HCL, the Committee would like to be apprised of the future strategy of HCL to overcome the constraints faced by the company to improve its operating efficiency and become a market leader.

Mineral Exploration Company Limited (MECL)

13. The Committee note that MECL is engaged in detailed mineral exploration for various minerals such as Coal, Lignite, Copper, Lead, Zinc, Gold, Iron Ore, Lime Stone and Bauxite etc. except Oil & Natural Gas. MECL projects are executed as promotional exploration for Ministry of Mines and Ministry of Coal and contractual work for Central / State Governments, PSUs and Private Sectors. The R&D expenditure by MECL during 2012-13, 2013-14 and 2014-15 are Rs. 15.75 lakh, Rs. 29.95 lakh and Rs. 39.33 lakh respectively. MECL has identified the limitation of a single method of Surface Geophysical survey technique due to complicated Geological set up. Research and Development Projects have been conceived with a basic objective to establish an integrated method of different techniques which can be fruitfully adapted for exploration of any type of Sulphide ore deposit such as massive/ disseminated and map their subsurface disposition, continuation and structural features in comparatively lesser time as well as at lesser cost. Under the scheme of R&D work, all the projects were formulated with the help of National Geophysical Research Institute (NGRI), Hyderabad. According to the Ministry there are no such sanctioned posts of Scientists /Engineers for R&D in MECL. The Scientists and Engineers in MECL carry out R&D work as and when required. Taking note of the reported lack of adequate

infrastructure and manpower as the main constraint faced in the implementation of R&D projects by MECL, the Committee recommend that MECL should start recruiting scientists and depute them for R&D work in mineral exploration to improve the quality of drilling activity and reducing the wear and tear of drill machines and other tools/equipments.

Need to Increase R&D Investment

14. Keeping in view low expenditure for R&D activities by the PSUs of the Ministry of Mines the Committee desire that Mining Sector PSUs must look into this aspect seriously and take adequate steps to increase their R&D investment and achieve not only the stipulated target of 1% of their profit after tax as R&D expenditure but also take necessary steps to ensure utilization of 1% of the total turnover of the Company by the terminal year of the 12th Plan i.e. 2016-17. The Committee also recommend that the Ministry should issue necessary directions to PSUs as well as private sector companies to chalk out a strategy for increasing expenditure on R&D activities and desire that the Ministry should take necessary steps to ensure setting up of Centralized R&D organization like Steel Research and Technology Mission of India (SRTMI) in the steel industry to ensure concerted and coordinated system of R&D in Mining Sector in the Country.

Attached and Subordinate Offices

Geological Survey of India (GSI)

15. The Committee note that GSI's main focus is to establish subsurface behavior of the mineralization, tonnage and methodology to obtain best yield of

concerned commodity. The three National Centers for Geoscience Research (NCEGR) of GSI situated at Kolkata, Bengaluru and Faridabad are engaged in research on mineral characterization and ore beneficiation. GSI has taken up research projects on Platinoid Group of Elements (PGE) Exploration, Polymetallic minerals, coal, gold exploration etc. Another area of research related to the exploration of minerals is National Geochemical Mapping (NGCM). Further, new concept oriented approach in the form of Hyper Spectral Mapping has been initiated to understand the nature of ore deposit and alteration pattern. The Committee were also informed that the State-of-the-art scientific vessel R.V. Samudra Ratnakar has been procured by GSI in 2013 having 27 scientific equipment fitted on-board for geological, geophysical and geochemical exploration of the sea bed for establishment off shore marine mineral resource and research in Exclusive Economic Zone (EEZ) of India. The Committee are, however, concerned to note that against the sanctioned strength of 6665 personnel in S&T streams in GSI as on 31.1.2016, the actual filled strength is only 3466. There are 1486 vacancies in the stream of Geology, 371 in Geophysics, 622 in Chemistry and 720 vacancies in Engineering stream. Although, the Ministry have informed that a perspective plan for recruitment to various posts in S&T stream has been prepared, the Committee feel that such a huge shortage of personnel in S&T stream will adversely affect the various fundamental research projects of GSI and these projects cannot be carried out in mission-mode. The Committee, therefore, recommend that the sanctioned strength of GSI in S&T

stream be immediately filled up and they be apprised of the action taken in the matter.

Indian Bureau of Mines (IBM)

16. The Committee observe that one of the major developmental function of IBM is to play a role of a catalytic agency to promote and develop the much needed R&D in mineral processing in the field of mineral beneficiation, mineral characterization, chemical analysis of ores and minerals and analysis of environmental samples. Against the RE of Rs. 5.91 crore for R&D investment in IBM during 2013-14, the actual expenditure was Rs. 5.56 crore and against RE of Rs. 6.56 crore during 2014-15, the actuals were Rs. 5.78 crore. According to the Ministry of Mines "Mineral Processing (Erstwhile Ore Dressing) Division of IBM carries out R&D studies in the field of mineral beneficiation. It's Modern Mineral Processing Laboratory (MMPL) and Pilot Plant comprising of Ore Dressing Laboratory, Mineral Beneficiation Pilot Plant, and Analytical Laboratory Complex established with the assistance of UNDP is well equipped with state-of-the-art facilities to carry out R&D studies in the field of mineral beneficiation and mineral characterization, and analysis of environmental samples. The Bureau has zone-wise facilities in mineral testing and beneficiation with regional ore dressing laboratory and pilot plants at Ajmer and Bangalore which are also well equipped with sophisticated equipment. A 'Clay Laboratory' has also been established to cater to the needs of the north-eastern region exclusively. Taking note of the static performance of IBM for ore Dressing Investigation and Mineralogical examination varying from 55 to 65 and 2060 to 2509 during the last 5 years and

declining Chemical Analysis carried out by Mineral Processing unit from 49,139 during 2011-12 to 34,660 during 2014-15, the Committee would like to apprised of the reasons for the same. The Committee would also like to be informed about the steps taken by the IBM to improve the performance of its Mineral Processing Division.

Vision Document to Promote R&D

17. The Committee find that Research and Development in the mining sector holds the key to maximize efforts towards more productivity in the exploration and extraction of many minerals which the Country is abundantly blessed with. The Committee observe that India's ranking is poorly placed on many parameters pertaining to R&D sector in the global scenario. While it is recognized that only a holistic approach towards meeting the various challenges facing and constraints being faced in the R&D initiatives of Indian Mining Sector would only result in a positive outcomes, the Committee desire that the Government come out with a Vision Document to promote R&D in mining sector, which goes beyond the objectives and targets set out in the National Mineral Policy, 2008 as well as in the Guidelines for Mineral Research Support, 2013. The Committee appreciate the laudable initiatives put in place by various institutes working in the R&D sector of the Mining Industry and hope that earnest efforts are made to raise the dismal position of India's ranking in the Global scenario. The Committee may be apprised of the action taken in the matter.

NEW DELHI;
9 August, 2016
18 Shravana, 1938(Saka)

RAKESH SINGH
Chairperson
Standing Committee on Coal and Steel

Annexure-I

MINUTES OF THE SITTING OF THE STANDING COMMITTEE ON COAL AND STEEL HELD ON 30TH SEPTEMBER, 2015 IN COMMITTEE ROOM 'C', PARLIAMENT HOUSE ANNEXE, NEW DELHI.

The Committee sat from 1130 hrs. to 1330 hrs.

PRESENT

Shri Rakesh Singh - Chairperson

Lok Sabha

34. Shrimati Jyoti Dhurve
35. Shri Godam Nagesh
36. Shri Faggan Singh Kulaste
37. Dr. Banshilal Mahato
38. Shri Devji Mansingram Patel
39. Shrimati Riti Pathak
40. Shrimati Ranjit Ranjan
41. Dr. Ravindra Kumar Ray
42. Shri Tamradhwaj Sahu
43. Shri Tathagata Satpathy
44. Shri Janardan Singh "Sigriwal"
45. Shri Pashupati Nath Singh
46. Shri Rama Kishore Singh
47. Shri Sunil Kumar Singh
48. Shri Krupal Balaji Tumane

Rajya Sabha

49. Shri M.J. Akbar
50. Dr. Pradeep Kumar Balmuchu
51. Shri Md. Nadimul Haque
52. Shri B.K Hariprasad
53. Shri Jugul Kishore

54. Shri Avinash Pande
55. Shri Sanjay Raut

SECRETARIAT

1.	Shri Ravindra Garimella	-	Joint Secretary
2.	Shri Ajay K. Garg	-	Director
3.	Shri Arvind Sharma	-	Additional Director
4.	Ms. Miranda Ingudam	-	Deputy Secretary

WITNESSES

MINISTRY OF MINES AND ITS PSU's

Sl. No.	Name	Designation
1.	Shri Balvinder Kumar	Secretary
2.	Shri R. Sridharan	Additional Secretary
3.	Shri Nikunja Bihari Dhal	Joint Secretary
4.	Shri Sudhaker Shukla	Economic Advisor
5.	Dr. Joyesh Bagchi	Director (Tech.)
6.	Shri T.K. Chand	CMD, NALCO
7.	Shri K. D. Diwan	CMD, HCL
8.	Dr. Gopal Dhawan	CMD, MECL
9.	Dr. Anupam Agnihotri	Director, Jawaharlal Nehru Aluminum Research Development & Design Centre
10.	Shri V. Venkateswarlu	Director, National Institute of Rock Mechanics
11.	Dr. K. Balasubramanian	Director, Non Ferrous Materials Technlogy Development Centre

2. At the outset, the Chairperson welcomed the Secretary, CMDs and other representatives of the Ministry of Mines to the sitting of the Committee convened in connection with examination of the subject, "Science and Technology/Research and Development in Mining Sector." The Chairperson then drew attention of the witnesses to the provisions of the Direction 55 of the Directions by the Speaker, Lok Sabha.

3. Thereafter, a visual presentation was made by the representatives of the Ministry of Mines, respective CMDs and other concerned organisaions. The Committee broadly discussed the issues relating to Amendment in the Mines and Minerals(Development & Regulation) Act; Constitution of District Mineral Foundation for the development and welfare of persons affected due to mining activities; Grant in aid to the Autonomous bodies under Research & Development component; Role of mining sector in GDP of the country; one time grant to autonomous bodies during 12th Five Year Plan for purchase of equipments; Constitution of National Mineral Exploration Trust (NMET) for detailed exploration of resources by Geological Survey of India and Mineral Exploration Corporation Ltd.; provision of one percent of total revenue or total budget to be invested on R&D activities by PSUs and autonomous bodies; patents pertaining to R & D activities in the mining sector; reasons for less expenditure incurred

on R&D activities by NALCO; Health problems in mining areas; investment of Rs. 6.5 crore by HCL and Rs. 40 crore by NALCO in the last three to four years under R&D activities; Research work being carried out by nine institutions- three PSUs, two subordinate and attached offices of GSI and IBM and four autonomous bodies and shortage of skilled manpower in those institutions; and need for increased budget on R&D activities.

4. The Members raised their concerns on the above issues and sought clarifications from the representatives of the Ministry of Mines. The Chairperson directed the representatives of the Ministry of Mines to furnish written replies to the queries raised by the Members which could not be responded to within fifteen days.

A copy of verbatim proceedings of the sitting of the Committee has been kept on record.

The Committee then adjourned

Annexure-II

MINUTES OF THE SITTING OF THE STANDING COMMITTEE ON COAL AND STEEL HELD ON 16th FEBRUARY, 2016 IN COMMITTEE ROOM No. 139, PARLIAMENT HOUSE ANNEXE, NEW DELHI.

The Committee sat from 1130 hrs. to 1430 hrs.

PRESENT

Shri Rakesh Singh- Chairperson

Lok Sabha

2. Shri A Arunmozhithevan
3. Shri Shailesh Kumar
4. Dr. Banshilal Mahato
5. Shrimati Ranjit Ranjan
6. Dr. Ravindra Kumar Ray
7. Shri Tamradhwaj Sahu
8. SHri Tathagata Satpathy
9. Shri Janardan Singh "Sigriwal"
10. Shri Pashupati Nath Singh
11. Shri Rama Kishore Singh
12. Shri Sunil Kumar Singh
13. Shri Sushil Kumar Singh

Rajya Sabha

14. Shri Ali Anwar Ansari

SECRETARIAT

1.	Shri U.B.S. Negi	-	Joint Secretary
2.	Shri Ajay Kumar Garg	-	Director
3.	Shri Arvind Sharma	-	Additional Director
4.	Ms. Miranda Ingudam	-	Deputy Secretary

WITNESSES

Ministry of Mines and its PSUs

Sl. No.	Name	Designation
1.	Shri Balvinder Kumar	Secretary, Ministry of Mines
2.	Shri R. Sridharan	Additional Secretary, Ministry of Mines
3.	Dr. Niranjan Kumar Singh	Joint Secretary, Ministry of Mines
4.	Shri Nikunja Bihari Dhal	Joint Secretary, Ministry of Mines
5.	Shri Subhash Chandra	Joint Secretary, Ministry of Mines
6.	Shri Sudhaker Shukla	Economic Advisor, Ministry of Mines
7.	Smt. Farida M. Naik	Director, Ministry of Mines
8.	Dr. Joyesh Bagchi	Director (Tech.), Ministry of Mines
9.	Dr. Anupam Agnihotri	Director, Jawaharlal Nehru Aluminum Research Development & Design Centre
10.	Shri V. Venkateswarlu	Director, National Institute of Rock Mechanics
11.	Dr. Rajnarayan R. Tiwari	Director, National Institute of Miners' Health
12.	Shri N. R. Mohanthi	Director (Project), NALCO
13.	Dr. B. K. Satpathy	Exe. Director, NALCO
14.	Dr. Gopal Dhawan	CMD, MECL
15.	Shri K. D. Diwan	CMD, HCL
16.	Shri J. N. Das	Dy. Director General, GSI
17.	Shri R. K. Sinha	Controller General (I/c), IBM
18.	Smt. Indira Ravindran	Director, IBM
19.	Dr. K. Balasubramanian	Director, Non Ferrous Materials Technology Development Centre

2. At the outset, the Chairperson welcomed the Secretary and other representatives of the Ministry of Mines and its PSUs to the sitting of the Committee convened in connection with examination of the subject, "Science & Technology/Research & Development (R&D) in Mining Sector". The Chairperson then drew attention of the witnesses to Direction 55 of the "Directions by the Speaker, Lok Sabha.

3. Thereafter, a visual presentation on the subject was made by representatives of Ministry of Mines which included the highlights of the thrust areas of R&D activities taken up by the autonomous bodies under purview of the Ministry viz: National Institute of Rock Mechanics (NIRM), Bengaluru; National Institute of Miners' Health (NIMH), Nagpur; Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur; Non-Ferrous materials Technology Development Centre (NFTDC), Hyderabad; National Aluminium Company Ltd. (NALCO), Bhubaneswar; Hindustan Copper Ltd.(HCL), Kolkata;

Mineral Exploration Corporation Ltd. (MECL), Nagpur; Geological Survey of India (GSI), Kolkata; and Indian Bureau of Mines (IBM), Nagpur. The Committee broadly discussed the issues relating to need for improving efficiency in process, research in mining methods and mineral beneficiation; R&D expenditure in mining sector and parameters for deciding a country's ranking in R&D Sector, utilization of industrial waste to realize value added commercial products for environmental sustenance; recruitment of additional persons for R&D in NALCO; development of new aluminium alloys and value added products; integrated methods of different techniques for exploration; application of Advance Geophysical Technology for identification of deep seated potash deposit in collaboration with National Geophysical Research Institute (NGRI) in MECL; pre-concentration of heavy minerals i.e. Rare Earth Elements (REE) by physical separation; potential of Mining in North Eastern Region; Monitoring Mechanism in R&D works and achievement in R&D sector; level of R&D activities in Bauxite deposits and low grade minerals; time bound road map to achieve the R&D targets set, etc.

4. The Members raised their queries on the above issues and the clarifications were furnished by the representatives of the Ministry of Mines. On a futuristic note, the Committee were also apprised of the future plans for development and indigenization of Aluminium alloys for defence, aerospace, automobiles and construction sector; Recycling of aluminium for secondary aluminium industry; Noise Mapping in Mines and surrounding community with a vision of `Safe Mines and Healthy Miners'; evolutions of new mining methods to promote productivity, safety and conservation in mines, etc. The Chairperson then directed the representatives of the Ministry of Mines to furnish written replies to the queries raised by the Members which could not be responded to.

A copy of verbatim proceedings of the sitting of the Committee has been kept on record separately.

The Committee then adjourned

Annexure-III

MINUTES OF THE SITTING OF THE STANDING COMMITTEE ON COAL AND STEEL HELD ON 9th August, 2016 IN ROOM NO. '112', FIRST FLOOR, PARLIAMENT HOUSE ANNEXE, NEW DELHI.

The Committee sat from 1500 hrs. to 1530 hrs.

PRESENT

Shri Rakesh Singh - Chairperson

Lok Sabha

2. Shri A. Arunmozhithevan
3. Shri Kalyan Banerjee
4. Smt. Jyoti Dhurve
5. Shri Shailesh Kumar
6. Shri Devji M. Patel
7. Smt. Riti Pathak
8. Smt. Ranjit Ranjan
9. Dr. Ravindra Kumar Ray
10. Shri Tamradhwaj Sahu
11. Shri Tathagata Satpathy
12. Shri Janardan Singh"Sigriwal"
13. Shri Pashupati Nath Singh
14. Shri Sunil Kumar Singh
15. Shri Sushil Kumar Singh
16. Shri Krupal Balaji Tumane

Rajya Sabha

17. Dr. Pradeep Kumar Balmuchu

SECRETARIAT

1. Shri U.B.S. Negi - Joint Secretary
2. Shri Ajay Kumar Garg - Director
3. Shri Arvind Sharma - Additional Director
4. Ms. Miranda Ingudam - Deputy Secretary

2. At the outset, Chairperson welcomed the Members to the sitting of the

Committee.

3. The Committee thereafter took up for consideration the following Draft Reports:-

(i) ** ** ** **

(ii) Draft Report on "Science & Technology/Research & Development in Mining Sector" of the Ministry of Mines; and

(iii) ** ** ** **

4. The Committee also considered the letter of dissent dated 09.08.2016 given by Shri Tathagata Satpathy, M.P. in respect of certain recommendations contained in its draft Report relating to "Research & Development in Iron and Steel Sector" of the Ministry of Steel.

5. The Committee adopted the Reports with minor changes/modifications in Draft Report on "Research and Development in Iron and Steel Sector". The Committee decided that a copy of the aforesaid letter of dissent given by Shri Tathagata Satpathy be appended to the Report in terms of Rule 331I.(3) of Rules of Procedure and Conduct of Business in Lok Sabha. The Committee then authorized the Chairperson to finalise the Reports on the basis of factual verification from the concerned Ministries and present the same to both the Houses of Parliament.

The Committee then adjourned.

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**Do not pertain to this Report